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Renewable energy technologies/sources path within EU 2020 strategy

Analysis according to national renewable energy action plans and 2013 progress reports

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Abstract

Title Renewable energy technologies/sources path within EU 2020 strategy

Renewable energy technologies/sources (hydropower, wind power, solar power, marine-energy, geothermal energy, heat pumps, biomass and biofuels) are alternatives to fossil fuels contributing to the improvement of environment, enhancement of energy security and diversification of energy supply.
In line with Article 4 and Article 22 of the Directive 2009/28/EC Member States (MS) have submitted to the European Commission their national renewable energy action plans (NREAPs) and biennial progress reports. This report contains an analysis of these documents and a summary of data at the EU level, providing also a view of each MS situation, the progress of each technology/sources from the baseline year 2005 to 2012 and the pathways to 2020 in three main sectors: Electricity, Heating/Cooling and Transport.
Biomass is and will remain the main renewable energy source in the European Union although in relative terms its contribution will decrease from 53.7% in 2012 to 45% in 2020 due to the fast penetration of new renewable technologies, especially wind, PV and heat pumps. Between 2005 and 2012 more than 50% of additional renewable electricity in the EU was provided by wind power. Solar photovoltaics increased by a factor of 46 during the same time span whereas heat pumps increased their absolute contribution in heating/cooling sector by a factor larger than 10. In 2020 wind power will overcome hydropower becoming the second renewable energy source in the EU accounting for more than 17% of final renewable energy expected.

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Acknowledgements

This report was prepared by the Renewables and Energy Efficiency Unit, Institute for Energy and Transport (IET), Joint Research Centre (JRC) of European Commission (EC).

The database containing data for 28 national renewable energy action plans and the biennial progress reports submitted by each EU Member State to the European Commission is used as a source to analyse the progress of renewable energy technologies/sources in the European Union (EU).

The database was established under the support of Heinz Ossenbrink, the Head of the Renewables and Energy Efficiency Unit and it is available for download at IET webpage[1]. Manjola Banja and Fabio Monforti-Ferrario have the responsibility of its continuous maintenance and updating.

Manjola Banja has performed data analyses, drafted and finalized the present report co-authoring with Fabio Monforti-Ferrario, while Katalin Bódis has prepared the EU maps related to the current development of renewable energy technologies/sources in each Member States' and the expected progress up to year 2020.

[1] http://iet.jrc.ec.europa.eu/remea/national-renewable-energy-action-plans-nreaps

Executive Summary

Policy context: In its 2007 communication 'Renewable Energy Road Map — Renewable energies in the 21st century: building a more sustainable future' (COM (2006) 0848), which set out a long-term strategy for renewable energy in the European Union (EU) until 2020 and the creation of a new legislative framework. One of the priorities of the EU 2020 strategy is the acceleration of the development and deployment of low carbon technologies such as solar power, smart grids, and carbon capture and storage.

The Renewable Energy Directive, adopted by co-decision on 23 April 2009 (Directive 2009/28/EC, repealing Directives 2001/77/EC and 2003/30/EC), established that a mandatory 20% share of EU energy consumption must come from renewable energy sources by 2020, broken down into nationally binding sub-targets taking account of the Member States' different starting points. In addition, all Member States are required to obtain 10% of their transport gross final energy consumption from renewable sources by 2020. The directive also mapped out various mechanisms that Member States can apply in order to reach their targets (support schemes, guarantees of origin, joint projects, cooperation between Member States and third countries), as well as sustainability criteria for biofuels.

Key conclusion: Biomass is and will remain the main renewable energy source in the European Union even that in relative terms its contribution will decrease from 53.7% in 2012 to 45% in 2020 due to the fast penetration of new renewable technologies especially wind, PV and heat pumps. Between 2005 and 2012 more than 50% of additional renewable electricity in the EU was provided by wind power. Solar photovoltaics increased by a factor of 46 during the same time span whereas heat pumps multiplied by more than 10 their absolute contribution in heating/cooling sector. In 2020 wind power will overcome hydropower being the second renewable energy source in the EU accounting for more than 17% of final renewable energy expected.

Quick guide: This report provides an assessment of the progress of renewable energy technologies/sources in the EU from baseline year 2005 up to 2012 together with the expected development to reach the 2020 targets/plans. The assessment is based on data reported in Tables 10, 11 and 12 of national renewable energy action plans (NREAPs) and Tables 1b, 1c and 1d of renewable energy progress reports. The assessment aims to show how each renewable technology has evolved so far and how it is expected to evolve in order to achieve the 2020 planned values. The assessment is based on the absolute achieved level and average growth rates for different technologies for periods 2005-10, 2010-11, 2011-12 and the expected growth rates for 2012-20. Additional contribution in renewable energy installed capacity, renewable electricity and heat as well as renewable energy used in transport sector are analysed for each of above mentioned periods. The raw data on renewable technologies/sources for years 2005, 2012 and 2020 as well as the progress in absolute and relative terms of these technologies/sources are presented in the Annex of this report.

Related and future work: This report complements the set of reports on renewable energy development ([3], [4], [5], [6], [7], [8] and [9]) published by JRC-IET focusing on detailed analysis of renewable energy technologies/sources development based on NREAPs and progress reports which are submitted every two-years to the European Commission to identify the trend up to 2020 of the renewable energy development in three main sectors: Electricity, Heating/Cooling and Transport.

Main findings

Since 2005 the contribution of renewable energy technologies/sources in the EU has changed the shape of the final renewable energy mix progressing towards the penetration of "new" technologies as wind, solar and heat pumps.

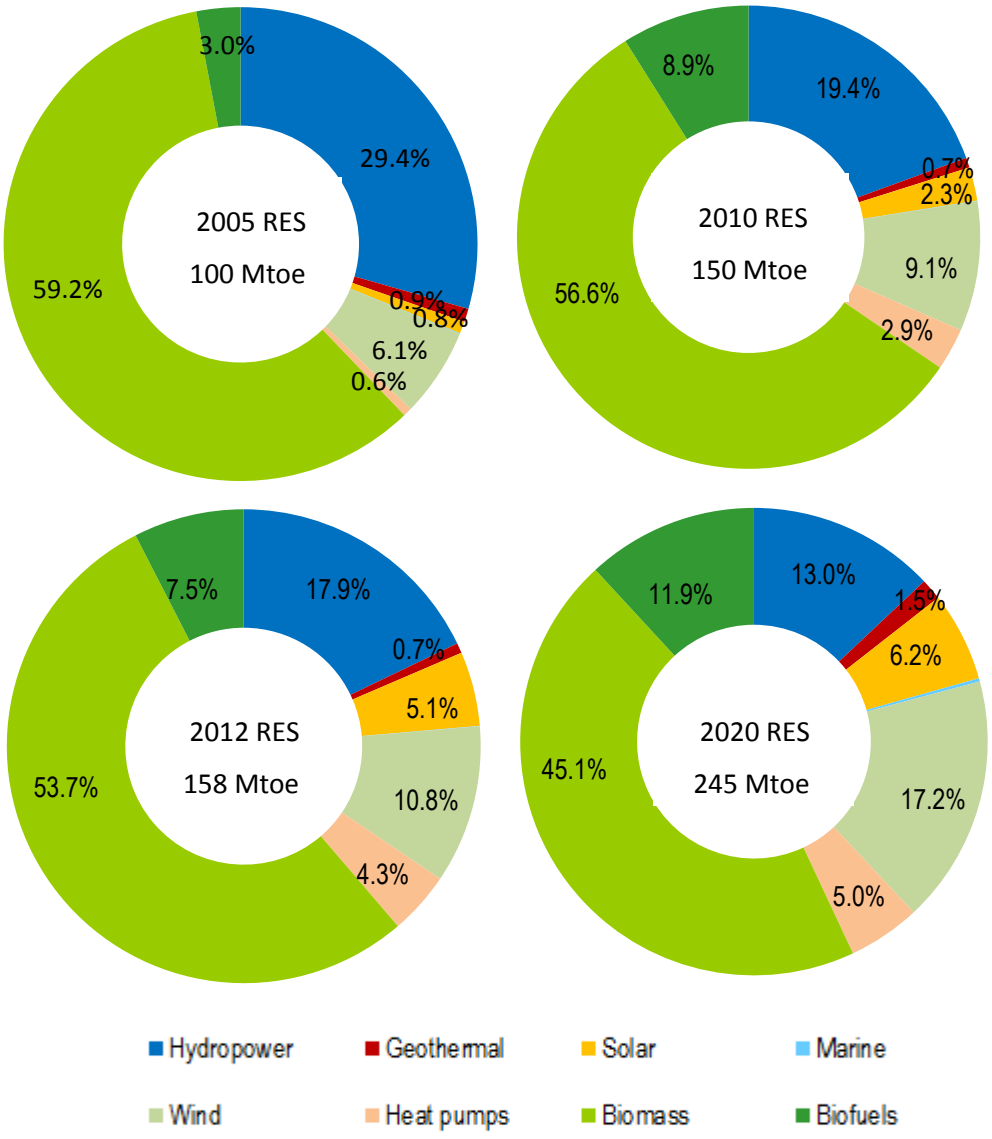

Figure 1. Breakdown of final renewable energy in the EU, 2005 – 2020[2]

[2] Source: Aggregated NREAPs for 2005 and 2020 and progress reports for 2011 and 2012.

Biomass and hydropower were the two main sources of final renewable energy in the EU in the baseline year (2005) contributing respectively with 60% and 30%. In 2010 the relative contribution of hydropower decreased by almost 10 percentage points (pp) whereas for biomass this decrease was only with 2.6 pp. Meanwhile in the same year the shares of biofuels, wind, heat pumps and solar technologies increased respectively by 5.9 pp, 3 pp, 2.3 pp and 1.5 pp. These trends continued also in 2012 except for biofuels which share decreased with 1.4 pp. In 2012 the biomass share in final renewable energy reached 53.7% followed by hydropower with 17.9%, wind with 10.8%, biofuels with 7.5%, solar with 5.1%, heat pumps with 4.3% and geothermal with 0.7%.

In 2020, the share of biomass in final renewable energy is expected to decrease down to 45.1% while the contribution of wind is expected to reach 17.2%. Hydropower will follow with 12.9% together with biofuels (11.9%), solar (6.2%), heat pumps (5%), geothermal (1.5%) and marine (0.2%).

Electricity sector

- The development of renewable energy in electricity sector between 2005 and 2012 benefited from the very fast penetration of new renewable technologies/sources as solar (mainly photovoltaics) and wind. Between 2011 and 2012 54% of the additional renewable electricity capacity in the EU was provided by photovoltaics while wind accounted for more than 35%;

- In 2012 hydropower technology provided 44% of renewable electricity that was consumed in the EU the same year whereas in 2020 this share will decrease to 30.5%. Nevertheless in absolute terms electricity generated by this technology is expected to increase from 2012 to 2020 by an additional contribution equal to 11.2% of the planned electricity generation in the target year;

- In relative terms renewable electricity from solar technology had the fastest development during period 2005-12 with a Compound Annual Growth Rate (CAGR) of 74.2%; in 2012 solar technology provided almost 10% of renewable electricity consumed in the EU;

- In 2012 photovoltaics represented 97% of solar technology installed capacity in the EU with a penetration of 22% in total renewable electricity installed capacity in the EU;

- The expected additional capacity of solar technology to be installed from 2013 to 2020 is equivalent to 21.8% of the planned 2020 value (90.5 GW); Its share in final renewable electricity capacity in 2020 is expected to decrease to 19% compared with 22.6% in 2012;

- Wind provided the highest absolute contribution to the increase of in renewable electricity production between 2005 and 2012, with +128 TWh (+461.4 PJ), almost half of total EU additional renewable electricity, +258.2 TWh (929.5 PJ), for the same period;

- The share of wind power capacity in total renewable electricity capacity installed in the EU reached 34% in 2012 whereas its contribution in final renewable electricity production reached 26.6%;

- 95% of wind power installed capacity in 2012 was onshore. Onshore wind provided 91% of wind renewable electricity in the EU the same year; In 2020 the contribution of onshore technology is expected to decrease to 80% of the wind renewable electricity;

- The expected additional contribution to renewable electricity from offshore wind from 2012 to 2020 is equivalent to 92.2% of the 2020 planned value (136.5 TWh i.e., 491.5 PJ) for this technology;

- Marine technology remained still in 2012 a very marginal contributor in final renewable electricity consumed in the EU with only 0.1%; Its contribution is expected to increase to provide 0.5% of final renewable electricity in the EU in 2020;

- Biomass used in electricity sector (bioelectricity) had increased by + 73 TWh (+262.8 PJ) between 2005 and 2012. Biomass contribution in final renewable electricity consumed in the EU in 2012 reached 19%; In 2020 bioelectricity contribution is expected to be increased by only +0.3pp;

Heating/Cooling sector

- Almost 90% of renewable heat consumed in the EU in 2012 was generated from biomass. The contribution of heat pumps, solar and geothermal was limited respectively to 8.25%, 2.3% and 0.7%;

- Solid biomass in heating/cooling sector increased by with + 22 Mtoe (+925.4 PJ) between 2005 and 2012 reaching in 2012 almost 87% of the 2020 planned figure of 80.9 Mtoe (3387 PJ);

- During the period 2005-12 heat pumps had the fastest development among technologies/sources in heating/cooling sector in the EU with +1031% (+6164 ktoe or 258 PJ);

- Bioliquids use in heating/cooling sector in the EU had a negative trend during period 2010-12 leaving 95.5% of the 2020 planned value of 4998 ktoe (209.3 PJ) to be developed between 2012 and 2020;

- More than half of biogas use planned for 2020, 4526 ktoe (189.5 PJ), is still to be deployed and it is expected to arise in the period 2012-20;

- The use of biomass in households developed faster than planned exceeding already in 2012 by almost 10% the expected 2020 value;

- Almost 10% of EU renewable heat in 2012 was used to feed district heating systems, while more than half of 2020 planned value for heat use in district heating (17.7 Mtoe, i.e., 741.3 PJ) is expected to be deployed between 2012 and 2020;

Transport sector

- Almost 70% of renewable energy used in transport sector in 2012 was in the form of biodiesel. Bioethanol/bio-ETBE contributed with 19.2% whereas renewable electricity and other biofuels contributed increased up to 10.2% and 1.7%;

- Use of biofuels in transport sector lagged behind the expectations reaching in 2012 almost 12 Mtoe or 41% of 2020 planned value. 85% of the 2012 figure was deployed between 2005 and 2010 whereas other periods experienced a decrease (2010-11) or a very slight increase (2011-12) in this indicator;

- The use of biofuels Art.21.2 has seen a very fast and stable increasing trend between 2005 and 2012 among other uses in transport sector with a CAGR of 80.9% reaching in 2012 almost 84% of 2020 planned deployment for this biofuels category. The main development took place between 2011 and 2012 with +904 ktoe (+37.8 PJ) which account for 42% of additional use for Art.21.2 biofuels during the seven year period;

- The highest additional amount of renewable energy in transport sector between 2005 and 2012 was provided by biodiesel, 72.8% of total additional use of 9181 ktoe (384.4 PJ) for the same period;

- In 2012 the share of bioethanol/bio-ETBE in final renewable energy in the EU was triple compare with this share in 2005. Almost two-thirds of bioethanol/bio-ETBE 2020 planned figure of 7324 ktoe (306.3 PJ) is expected to deploy during the 2012-20 period;

- Almost one-fourth of biofuels used in transport sector in the EU in 2012 was imported, mainly in the form of biodiesel (~80% of the transport biofuels imports);

- Renewable electricity use in transport sector developed very slowly with the highest increment taking place between 2010 and 2011. In 2012 more than 96% of renewable electricity was used in non-road transport and nearly 60% of 2020 planned figure is expected to deploy during the 2012-20 period.

Renewable energy deployment in 2013 progress[3]

- Hydropower decreased its relative contribution to the final renewable electricity consumed in the EU year 2013 to 42.4%, 1.2 pp below the 2012 value. The wind contribution decreased by 1 pp from 2012 level reaching 27.4% whereas the contribution of biomass reached 19.1%, 1 pp above the share in 2012. Marine and geothermal remained even in 2013 still marginal technologies in their contribution to renewable electricity in EU;

- The main development of renewable technologies/sources in electricity sector beyond 2013 is expected to take place in wind power with more than half of 2020 plan for this technology still to be deployed;

- Biomass is the renewable technology/source in electricity sector expected to have the second additional absolute contribution beyond 2013 with one-third of the 2020 plan for this source still to be deployed;

- On the contrary photovoltaics needs to increase by just 1.2 GWh after 2013 to reach the 2020 plan;

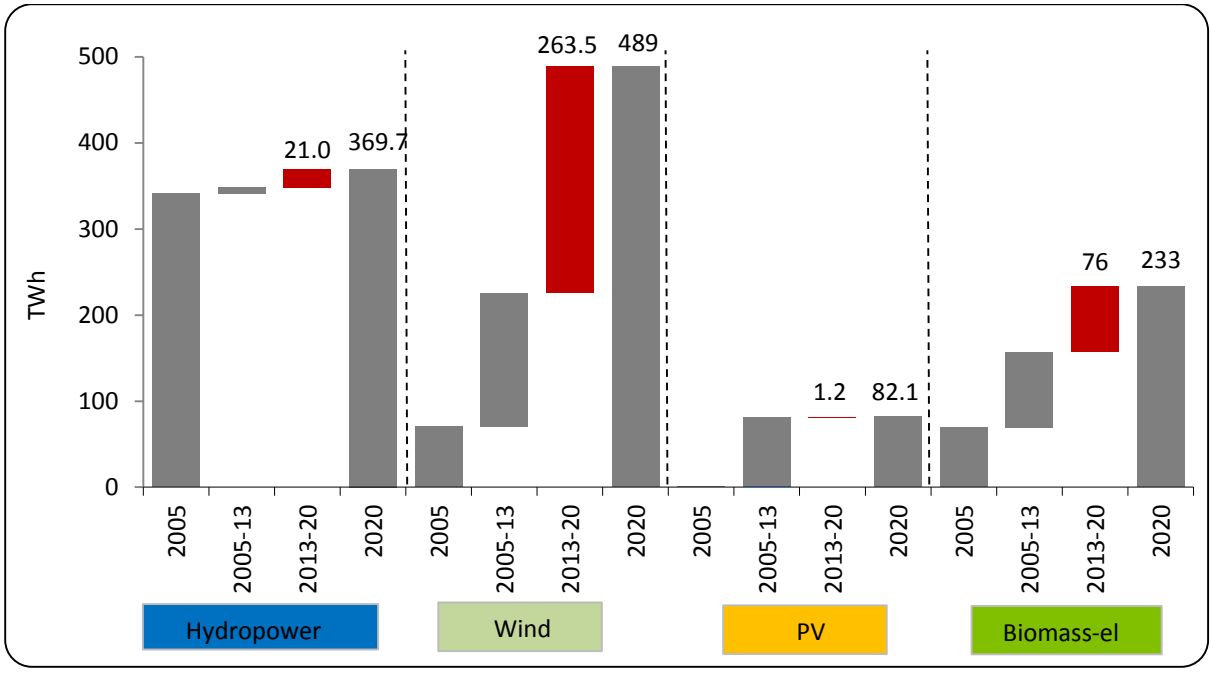

Figure 2. Achieved and **e**xpected development of renewable electricity technologies/sources in the EU, 2013 - 2020

[3] As 2013-2014 progress reports from Member States were not available in the time this report was finalized, no detailed analysis of the development of renewable energy technologies/sources after 2012 is included in this report. Nevertheless, in the sake of providing the reader a more updated vision, this section presents some summary on the deployment of electricity and heating/cooling renewable energy technologies/sources in 2013 in the EU and their 2013-2020 expected trends based on Eurostat SHARES 2013 data and 2014 EurObserv'ER Barometers.

- Biomass was still in 2013 the main renewable source in the heating/cooling sector in the EU keeping the same relative share as in 2012;

- Heat pumps contribution to final renewable heat in the EU increased slightly from 8.25% in 2012 to 8.36% in 2013;

- The additional contribution expected from solar technology used in heating/cooling sector during period 2013-20 is equivalent to almost 70% of the 2020 planned value for this technology;

- The use of biofuels in transport sector remained almost unchanged between 2012 and 2013 reaching 11.9 Mtoe, only 0.04% below the 2012 figure.

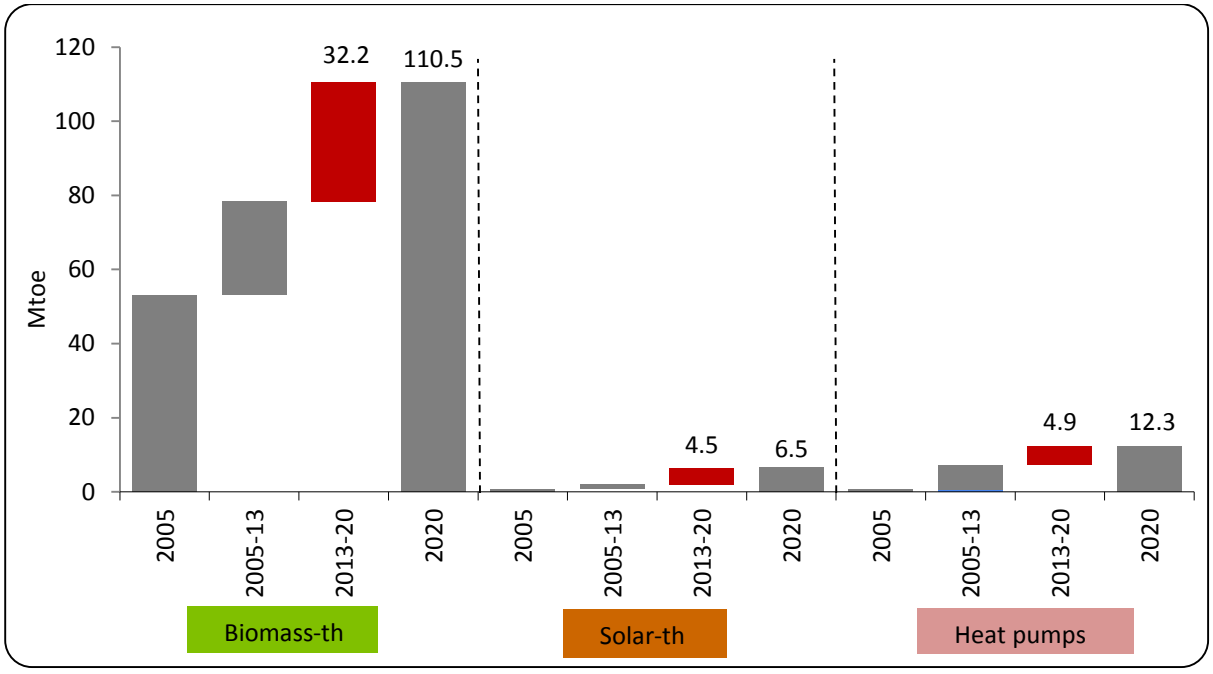

Figure 3. Achieved and expected development of renewable electricity technologies/sources in the EU, 2013 - 2020

How to read this report

This report presents the analysis of a large amount of data on renewable energy technologies/sources in the EU following two main approaches:

- absolute increase/decrease of a given technology/source during a multiannual or annual period and expected progress towards 2020; and

- relative increase/decrease of a certain technology/source during a multiannual or annual period and expected progress towards 2020.

Absolute increase/decrease analysis presents always the whole development of a certain technology/source in the EU during a multiannual or annual period (ex. 2005-10, 2010-11, 2011-12 or/and 2012-20).

Relative increase/decrease analysis presents the whole development in this terms as well as the average annual development of renewable energy technology/sources in the EU during a multi-annual period (actual or expected, depending on the period). The type of relative growth rate (annual or average) used is always stressed in the text. The relative growth rate used in this report is the "Compound Annual Growth Rate" (CAGR).

The report is accompanied by a set of thematic maps that present the current development and expected gap up to 2020 for each renewable technology/sources in each MS and sector.

Exceedances and unplanned achievements in 2012 by each Member State in each technology compared with the 2020 plans are presented in both 2012 and "gap to 2020" maps. The exceedances are highlighted by green colour whereas the unplanned achievements by pink colour in the "gap to 2020" maps.

Introduction

Renewable energy technologies/sources (hydropower, wind power, solar power, marine-energy, geothermal energy, heat pumps, biomass and biofuels) are alternatives to fossil fuels that contribute to reducing greenhouse gas emissions, diversifying energy supply and reducing dependence on fossil fuel markets, in particular oil and gas.

The European Union (EU) is a leader in renewable energy technologies. It holds 40% of the world's renewable energy patents and in 2012 almost half (44%) of the world's renewable electricity capacity (excluding hydropower) was located in the EU[4].

The EU 2020 targets are also the indispensable stepping stones to the future 2030 climate and energy targets. If the EU wants to remain a global leader in the fight against climate change and ensure its global leadership in renewables, all Member States (MS) will have to continue their efforts in increasing the share of renewable energy sources in their energy mix, so as to put the EU on a sustainable path to meeting the 2030 and 2050 targets[5].

The development of renewable energy technologies/sources in the EU is monitored by European Commission on the basis of the progress reports submitted every two years by its 28 Member States.

Up to now two sets of progress reports were submitted to the European Commission (EC) covering period 2009-10 and 2011-12[6]. The next set of progress reports, which will cover the development of renewable energy in European Union during the 2013-14, is expected to be submitted by MS to the European Commission by end December 2015.

In the present Joint Research Centre (JRC) report, data taken from these progress reports are analysed, compiled and summarized at the EU level, providing also a summary of renewable energy technologies deployment in each MS and the achieved and expected progress of each technology/sources from the 2005 baseline year up to 2020.

[4] http://www.europarl.europa.eu/atyourservice/en/displayFtu.html?ftuId=FTU_5.7.4.html
[5] http://europa.eu/rapid/press-release_MEMO-15-5181_en.htm
[6] https://ec.europa.eu/energy/en/topics/renewable-energy/progress-reports

Renewable energy technologies/sources in the EU 2005-12 and 2012-20

1. Hydropower

1.1 Installed capacity

Hydropower[7] installed capacity in the EU in year 2012 reached 105.4 GW, which resulted to be 0.9% (-5038 MW) lower than the baseline year level. The contribution of this technology in total renewable electricity capacity in this year was 33.7% compared with the expected contribution of 39.8%. The fastest development of this technology took place during period 2010-11 with a CAGR of 4.1% (+4.1 GW). Up to 2020 a development with a CAGR of 2.4% (+21.8 GW) is expected to take place in order to achieve the planned capacity of 127.2 GW.

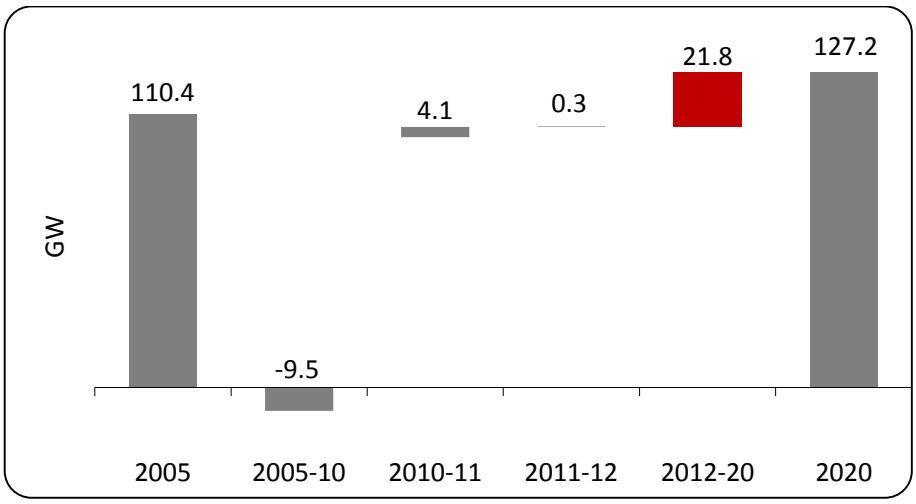

Figure 4. Hydropower installed capacity progress in the EU, 2005-2020

In 2012 in four Member States (DE, IE, LV and FI) hydropower installed capacity was higher than the 2020 planned capacity for this technology.

On the contrary, 15 Member States (BG, DK, EL, ES, FR, IT, LT, LU, NL, AT, PL, PT, RO, SK and UK) missed their plans on installed capacity hydropower development for year 2012.

France had in year 2012 the highest hydropower installed capacity with 18.7 GW followed by Sweden with 16.3 GW, Italy with 14.3 GW, Spain with 13.3 GW and Austria with 8 GW.

Penetration of hydropower capacity in renewable electricity capacity had the highest share in Latvia with 92.5% followed by Slovenia with 84.2%, Romania with 77.3%, Slovakia with 68.7% and Austria with 68%.

In order to reach 2020 targets, France is expected to need the highest absolute increase in hydropower capacity with +4.8 GW (CAGR +2.9%) followed by Portugal with +3.8 GW (CAGR +6.6%) and Italy with +3.5 GW (CAGR +2.8%).

[7] According to Directive 2009/28/EC the installed capacity of hydropower doesn't include the installed capacity of pumped storages.

1.2 Contribution to renewable electricity

Electricity production from hydropower technology in the EU reached 328.4 TWh (1182.2 PJ) in 2012 decreasing with a CAGR of 0.3% (-6.6 TWh) between 2005 and 2012. The share of hydropower technology in renewable electricity in 2012 was 44% compared with the 46% expected according aggregated NREAPs. Hydropower production increased only during period 2011-12 with a CAGR of 3.6% (+11.6 GWh). In 2020 the renewable electricity from hydropower is expected to reach 363 TWh (1306.8 PJ) while its contribution in renewable electricity for this year is expected to decrease to 30.5%.

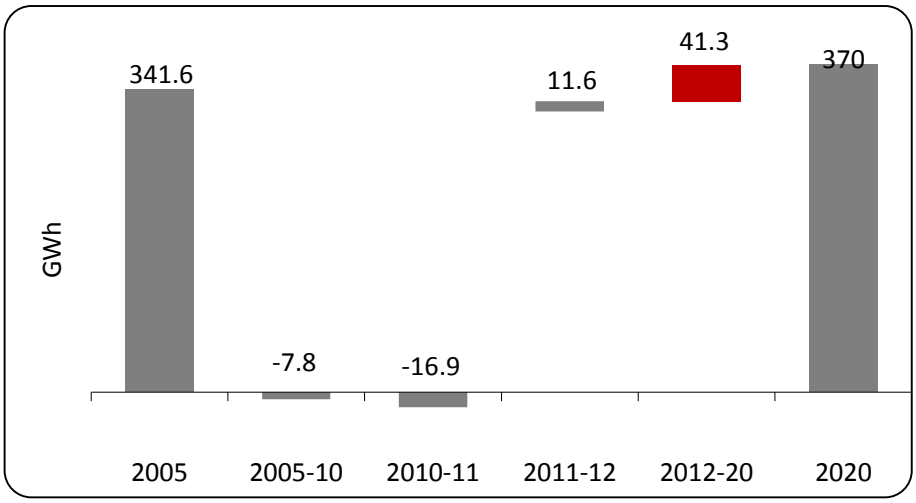

Figure 5. Hydropower renewable electricity progress in the EU, 2005-2020

Five Member States (BG, DE, IE, LV and SE) exceeded in 2012 their 2020 plans on renewable electricity production from hydropower technology among which Sweden had the highest absolute production above the 2020 plan (10.9 TWh above the target). Between 2005 and 2012, France had the highest absolute decrease hydropower electricity with 10.7 TWh (38.6 PJ) less.

In 2012, Sweden had the highest level of electricity production from hydropower reaching the amount of 78.9 TWh (284.1 PJ) followed by France with 59.5 TWh (214.2 PJ), Italy with 36.3 TWh (130.7 PJ), Austria with 35.5 TWh (127.7 PJ) and Spain with 27.6 TWh (99.3 PJ) while the highest share of the hydropower contribution to renewable electricity was found in Croatia (93.6%), Slovenia (90%), Latvia (89%), Austria (82.8%) and Romania (81%).

In 2020 the Member States leading hydropower will be France (71.7 TWh), Sweden (68 TWh), Austria (42.1 TWh), Italy (42 TWh) and Spain (32.8 TWh) while he highest share of hydropower technology in renewable electricity is expected in Slovenia with 83.6%, Austria with 80.4%, Croatia with 79.6%, Sweden with 69.9% and Slovakia with 67.5%.

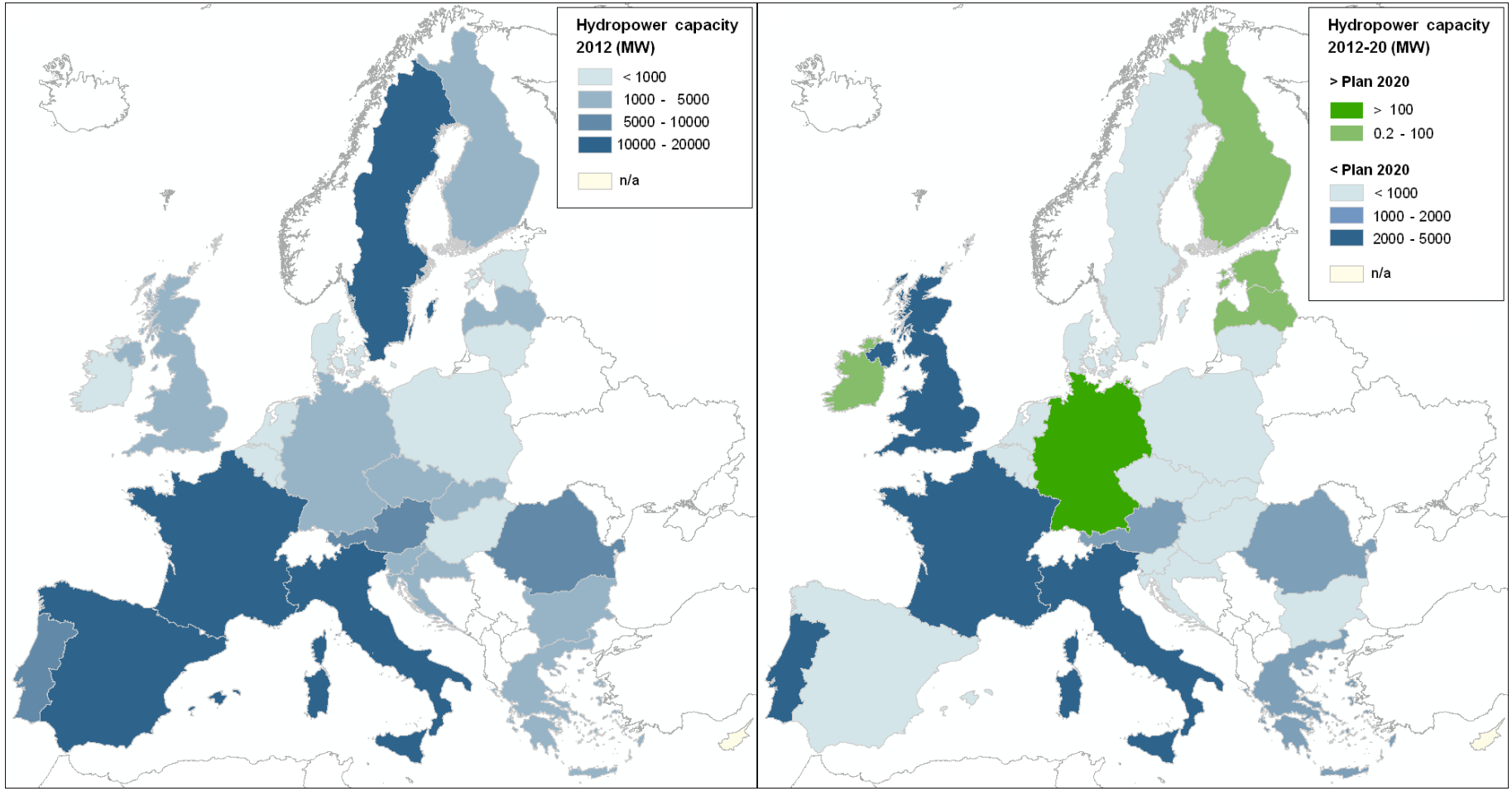

Figure 6. Hydropower installed capacity in each EU MS, 2012 (left) – gap to 2020 (right)

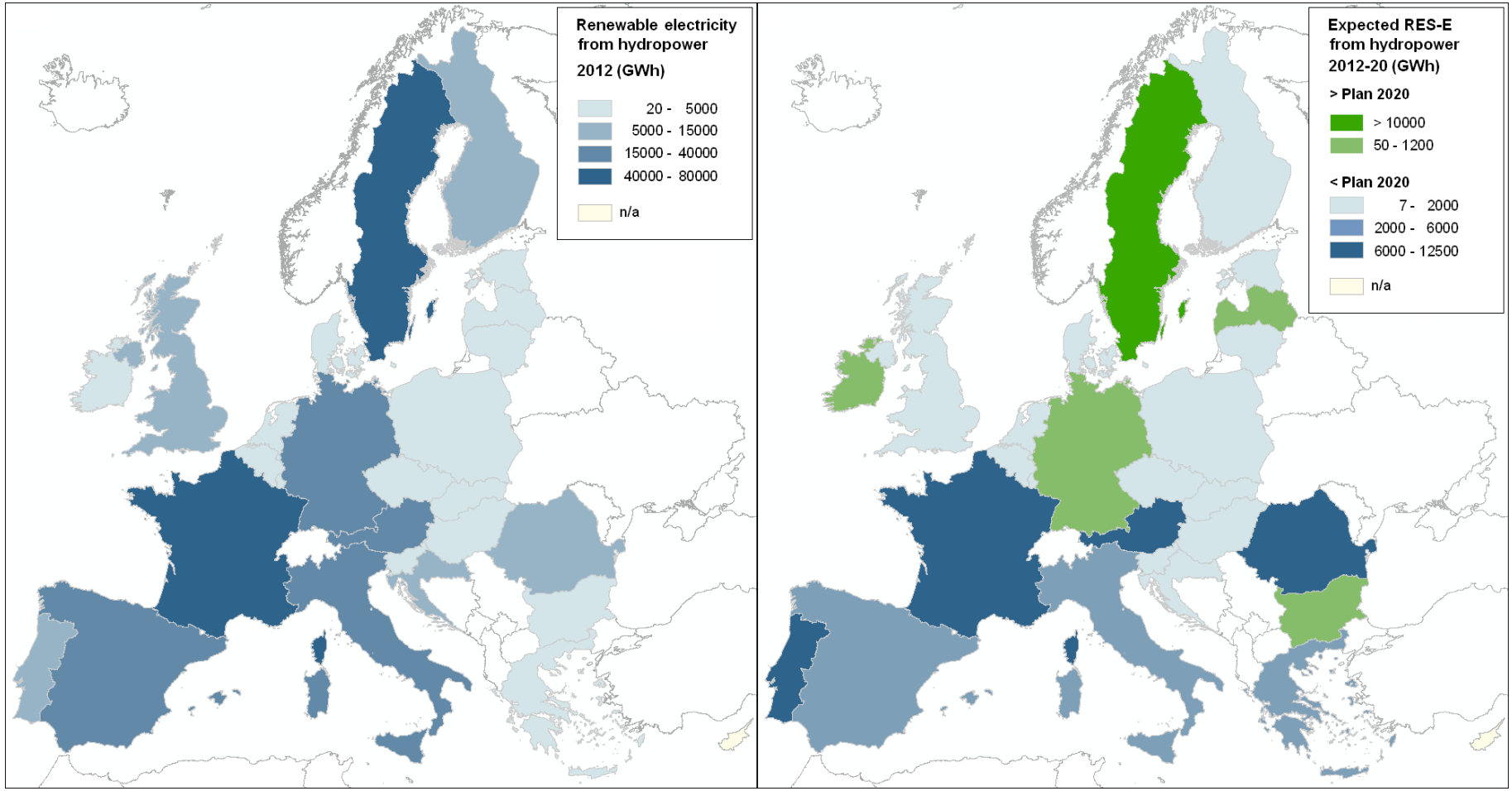

Figure 7. Renewable electricity from hydropower in each EU MS, 2012 (left) – gap to 2020 (left)

2. Geothermal

The use of geothermal energy for both electricity and heating/cooling reached in 2012 the level of 1091.1 ktoe (45.7 PJ) equivalent to about one-third of 2020 planned energy use for this technology. This absolute contribution was found to be 24.9% (-361.3 ktoe or 15.1 PJ) lower than the expected NREAPs level of 1452.4 ktoe (60.8 PJ) for year 2012. The fastest development of this technology took place between 2010 and 2011 with a CAGR of 7.2%. Geothermal share in final renewable energy in the EU remained still marginal reaching in 2012 only 0.7%. In 2020 geothermal absolute contribution is expected to amount to 3588.8 ktoe (150.3 PJ) increasing with a CAGR of 16% but still providing a very low relative contribution of 1.5%.

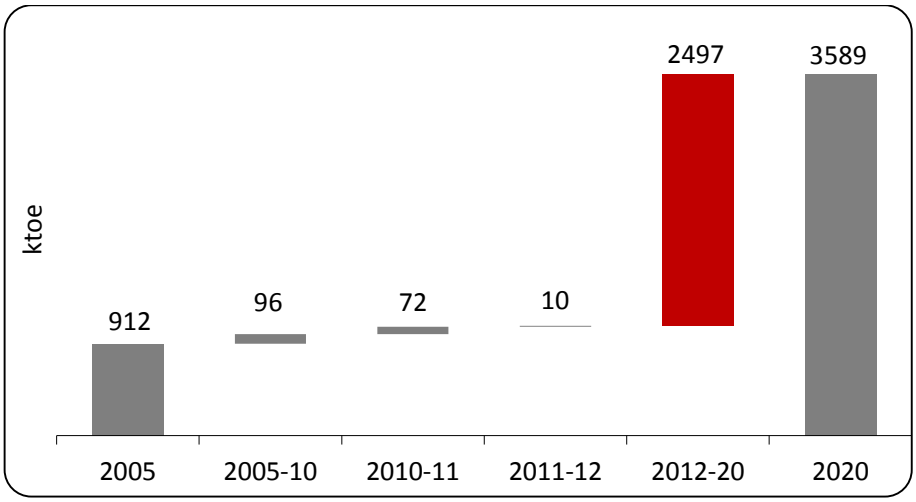

Figure 8. Geothermal technology (electricity and thermal) progress in the EU, 2005-2020

Slovenia developed faster than planned the geothermal technology exceeding in 2012 by 55% (+11 ktoe) the expected level for 2020.

Despite no plans to include geothermal technology in the contribution of final renewable energy, United Kingdom kept in 2012 the same level as in baseline year reaching 0.8 ktoe (0.03 PJ). Similarly, Bulgaria and Denmark reported on this technology since in 2009 despite no planned development.

Between 2005 and 2012 the contribution of geothermal technology decreased only two Member States (FR and IT), with a CAGR respectively equal to -4.2% (-39.78 ktoe) and -1.1% (-56.04 ktoe) despite the fact that an increase with CAGR 6.4% (+75.6 ktoe) and 1.5% (+71.7 ktoe) was expected according to their NREAPs.

In 2012, Italy had the highest absolute total geothermal energy production, with 614.9 ktoe (25.7 PJ) followed by Hungary with 107 ktoe (4.48 PJ), France with 98.4 ktoe (4.12 PJ) and Germany with 68.2 ktoe (2.85 PJ).

The highest absolute increase from the baseline year was reported by Germany with 56.13 ktoe (2.35 PJ). Although Spain had planned to maintain its geothermal energy production at

the same level of baseline year, in 2012 it's increased almost five-fold the geothermal contribution from 3.8 ktoe (0.16 PJ) in the baseline year.

Twelve Member States (BE, DE, EL, FR, IT, LT, HU, NL, AT, PL, PT and RO) missed their expected NREAPs levels for 2012. Italy had the highest negative deviation from its NREAP planned value with 127.7 ktoe less (-17.2%).

Up to 2020 Germany is expected to have the highest absolute increase with +760 ktoe (+31.8 PJ) followed by France with +442.5 ktoe (+18.5 PJ), Hungary with +285.3 ktoe (+11.9 PJ), Italy with +265.6 ktoe (+11.1 PJ) and the Netherlands with +247 ktoe (+10.3 PJ).

2.1 Geothermal electricity

2.1.a. Installed Capacity

Geothermal technology used in electricity sector reached in 2012 the installed capacity of 782 MW developing slower than expected according aggregated NREAPs. This technology increased with a CAGR of only 0.8% (+41 MW) between 2005 and 2012 compared with the expected CARG of 2.5% (+140 MW). This technology still remains a marginal one in the terms of contribution to the total renewable energy installed capacity with a contribution of 0.25% in year 2012 which was lower with 0.5 pp compared with the expected contribution according the aggregated NREAPs. In 2020 the EU is expected to more than double its geothermal capacity from the level of year 2012 reaching 1613 MW with a share equal to 0.33% in total expected renewable electricity capacity.

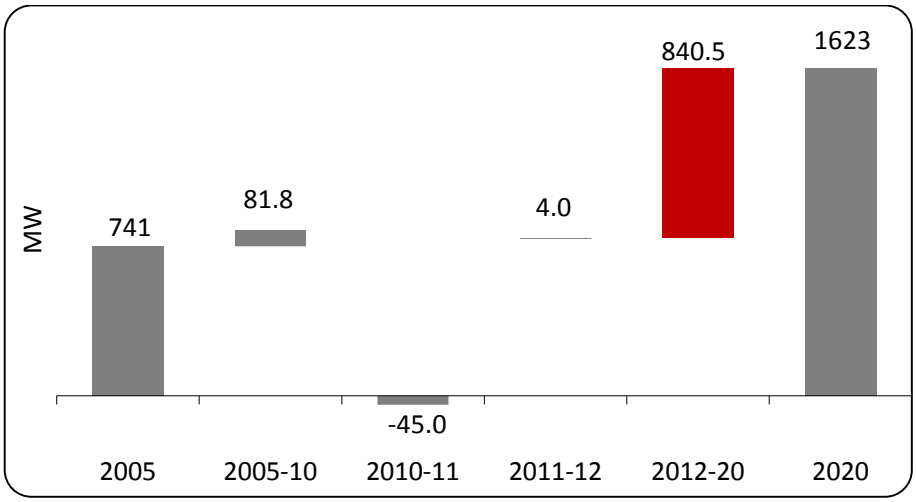

Figure 9. Geothermal installed capacity progress in the EU, 2005-2020

Italy remained the leading Member States in geothermal technology used in electricity sector reaching in 2012 the capacity of 728 MW representing already 93% of total geothermal installed capacity in EU-28.

Six Member States (DE, FR, IT, AT, PT and SK) have planned to contribute with this technology in the total renewable electricity capacity in year 2012. In fact the contribution of Slovakia was missing in this year while Germany, France and Italy reported lowest installed geothermal capacity than expected from their NREAPs. Austria and Portugal met

the plan for 2012 reaching respectively 1 MW and 25 MW installed capacity in geothermal technology.

In 2020 the number of Member States contributing with this technology in total renewable electricity capacity is expected to be increased to 12 with the contribution of BE, CZ, EL, ES, HR and HU. Italy will still remain the leading Member States in this technology with a capacity of 920 MW followed by Germany with 298 MW and Greece with 120 MW. Germany is expected to have the fastest development up to 2020 with a CAGR of 49.4% followed by France with a CAGR of 22.3% (+80 MW) and Portugal with a CAGR of 14.7% (+75 MW).

2.1.b. Contribution to renewable electricity

In 2012 the contribution of geothermal technology to the electricity sector reached 5815 GWh (20.9 PJ) equivalent to 0.78% of total renewable electricity and lower than both the planned contribution of 0.85% and the 2010 contribution of 0.9%. The fastest increase took place between 2010 and 2011 with a CAGR of 5.7% (+321 GWh / 27.6 PJ) while between 2011 and 2012 geothermal contribution decreased with a CAGR of 2.1% (-125 GWh / 10.8 PJ). Up to 2020 this technology is expected to reach to increase with a CAGR of 8.3% to reach 10964 GWh (39.5 PJ) with a contribution of 0.91% in total renewable electricity.

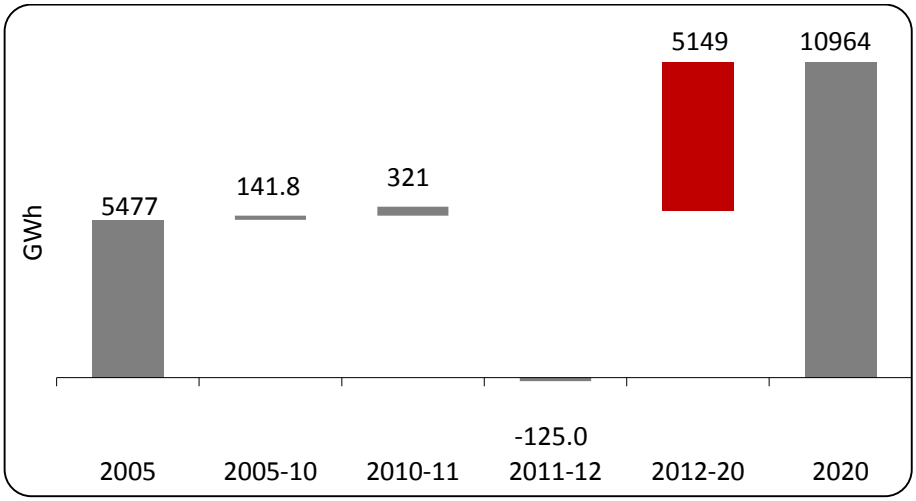

Figure 10. Geothermal renewable electricity progress in the EU, 2005-2020

In 2012 six Member States (DE, FR, IT, AT, RO and SK) contributing in geothermal electricity did not reach their plans. Italy was the leading Member State reaching in 2012 the amount of 5592 GWh (20.1 PJ) which was 4.5% (-264 GWh) lower than the planned level of 5856 GWh (21.1 PJ).

The development of renewable electricity from this technology in Germany developed with a CAGR of 99.3% which was lower than the planned one 142% reaching in 2012 the level of 25 GWh (0.09 PJ) almost three times lower than the plan. This technology developed slower than expected also in France being in 2012 below the baseline level of 95 GWh (0.34 PJ) with a negative CAGR of -8.5%, to be compared with the planned one of 12.6%. Geothermal electricity also developed slowly in Austria reaching in 2012 a contribution half of the baseline year level of 2 GWh (0.007 PJ).

In 2020 six other Member States (BE, CZ, EL, ES, HR and HU) will produce geothermal electricity adding a contribution of 1565 GWh (5.6 PJ). The fastest increase is expected to take place in Germany with a CAGR of 68.9% followed by France with a CAGR of 32.2% and Portugal with a CAGR of 16.3%.

Italy will still remain the leading country producing almost 62% (6750 GWh or 24.3 PJ) of the EU geothermal electricity followed by Germany with 1654 GWh (5.95 PJ), Greece with 736 GWh (2.64 PJ), Portugal with 488 GWh (1.76 PJ) and France with 475 GWh (1.7 PJ).

2.2 Geothermal heating/cooling

Geothermal heating/cooling in EU-28 increased during period 2005-2012 from the baseline level of 441.3 ktoe (18.5 PJ) with a CAGR of 4.3% (+150 ktoe), 6.5 pp lower than what was expected according to aggregated NREAPs. In 2012 this technology missed the NREAPs planned value by 34.7% (-314 ktoe) decreasing also its share in total renewable heat to 0.7% compared with expected 1.2%. The fastest development took place between 2010 and 2011 with a CAGR of 8.5% (+45 ktoe) compared with the CAGR of 3.6% during period 2005-2010 and 3.7% between 2011 and 2012. In 2020 the geothermal heat is expected to provide a contribution of 2.37% in total expected renewable heat with an absolute amount of 2645.9 ktoe (110.8 PJ) increasing with a CAGR of 20.6%.

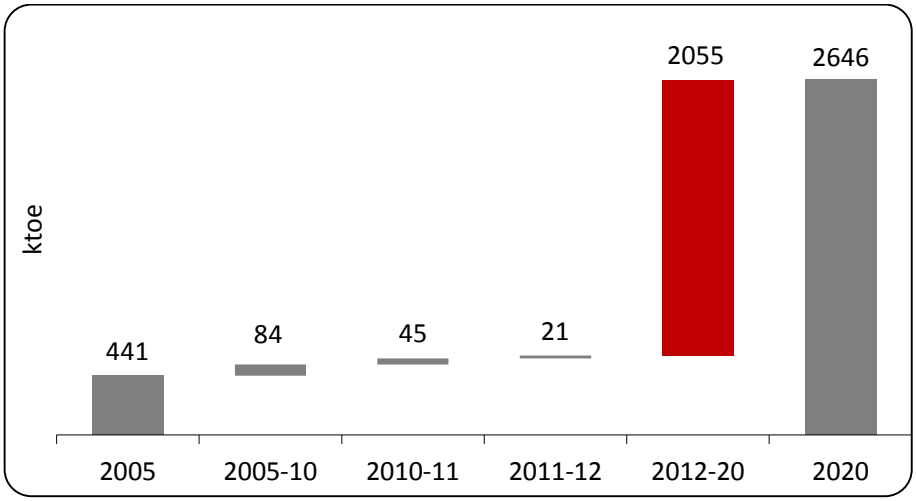

Figure 11. Geothermal renewable heat progress in the EU, 2005-2020

19 Member States (BE, BG, DK, DE, EL, ES, FR, IT, LT, HR, HU, NL, AT, PL, PT, RO, SI, SK and UK) contributed in 2012 to total renewable heat through this technology.

Italy was the leading country with 134 ktoe (5.61 PJ) followed by Hungary with 107 ktoe (4.48 PJ) and France with 94 ktoe (3.94 PJ).

The development of this technology in Bulgaria for heat purposes was very fast reaching in 2012 a level of 33 ktoe (1.38 PJ) which is 266% higher than the 2020 plan of 9 ktoe (0.38 PJ). Also Spain reached in 2012 an amount of 18 ktoe (0.75 PJ) which exceeds almost two times the 2020 plan of 9.5 ktoe (0.4 PJ). 11 Member States (BE, DE, EL, FR, IT, LT, HU, NL, PL, PT and RO) missed in 2012 their plans in heat production from geothermal technology while,

although the development of geothermal heat was not planned, Denmark reported in 2012 a contribution of 3 ktoe (0.13).

France and Italy had planned to reach a contribution higher than the baseline year during period 2005-2012 but in fact they reported lower values with a CAGR respectively -4.5% and -6.4% compared with baseline levels of 130 ktoe (5.44 PJ) and 213 ktoe (8.92 PJ).

In the same period, the fastest development of this technology took place in Germany with a CAGR of 27.6% (+54 ktoe) followed by Spain with a CAGR of 24.9% (+14 ktoe) and Slovakia with a CAGR of 10.4% (+3 ktoe).

In 2020 Germany is expected to lead with 686 ktoe (28.7 PJ) together with France with 500 ktoe (20.9 PJ) and Italy with 300 ktoe (12.6 PJ).

The fastest increase from 2012 values to reach the 2020 plans is expected to take place in Netherlands with a CAGR of 46.8% (+247 ktoe) due to ambitious plan that this Member States set in its NREAP. Also Portugal is expected to develop this technology with a CAGR of 41% (+23 ktoe) 2012 followed by Slovakia with a CAGR of 40.3% (+84 ktoe).

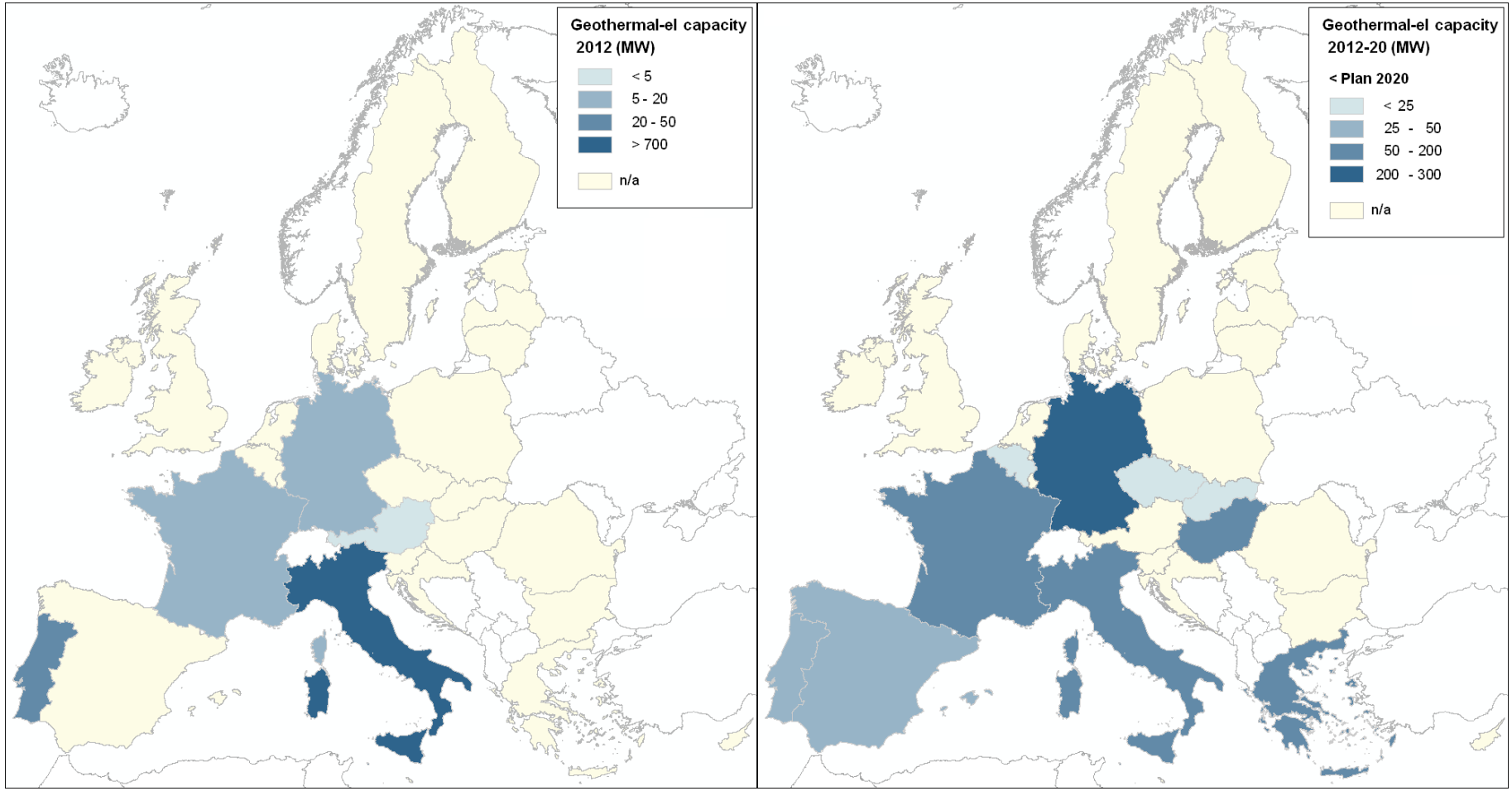

Figure 12. Geothermal installed capacity in each EU MS, 2012 (left) – gap to 2020 (right)

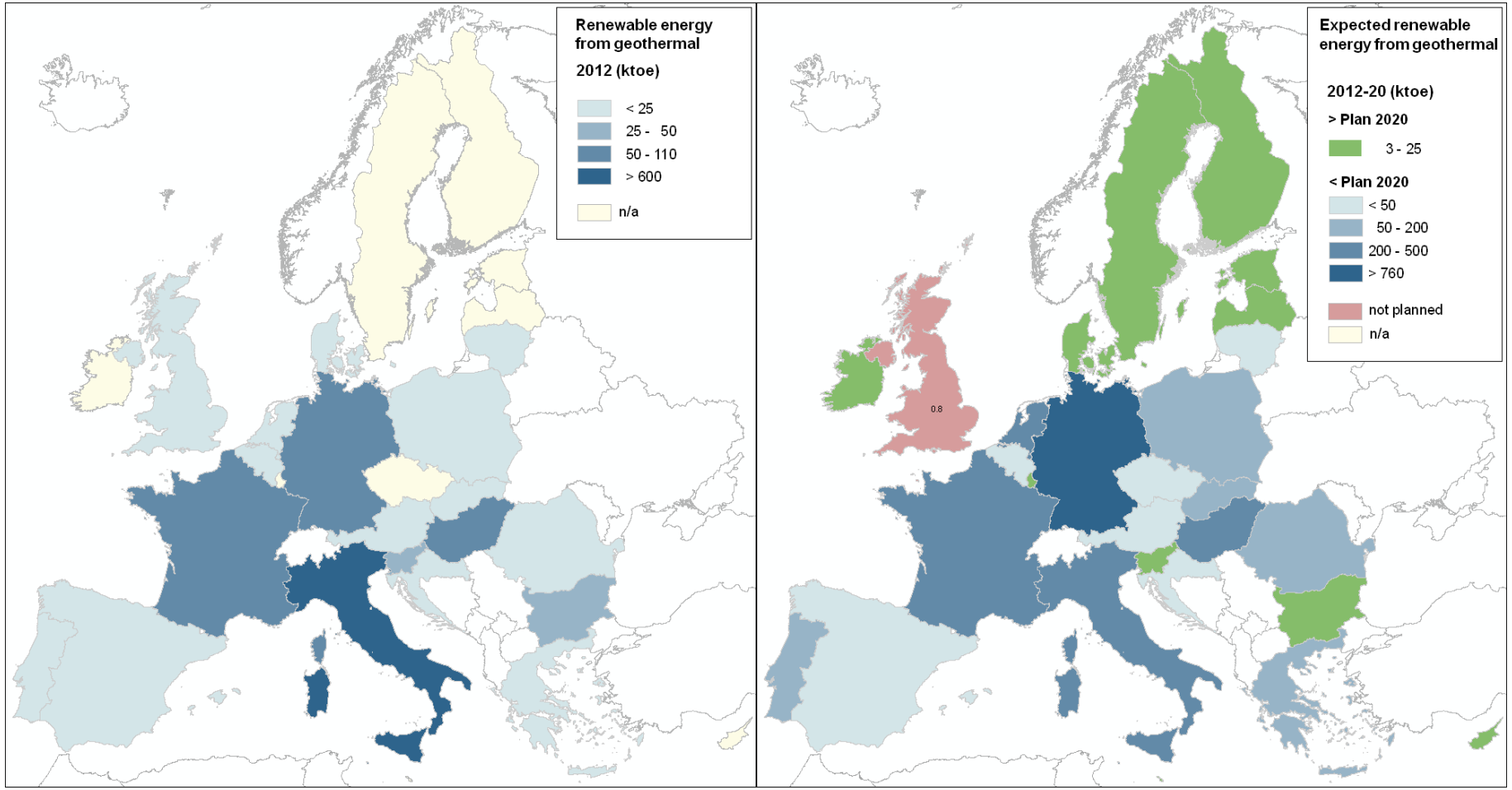

Figure 13. Renewable energy from geothermal technology in each EU MS, 2012 (left) – 2020 (right)

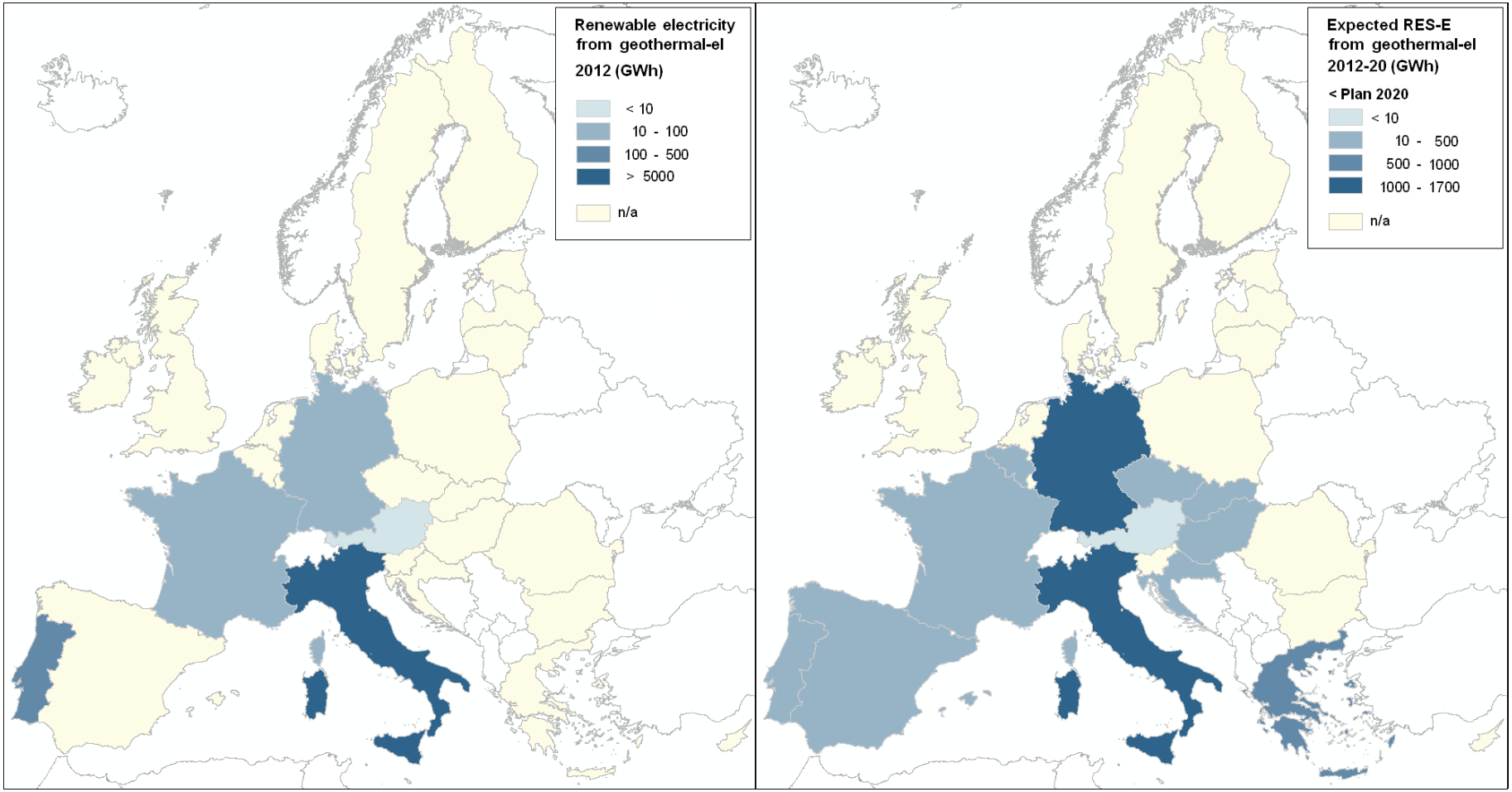

Figure 14. Renewable electricity from geothermal technology in each MS, 2012 (left) – gap to 2020 (right)

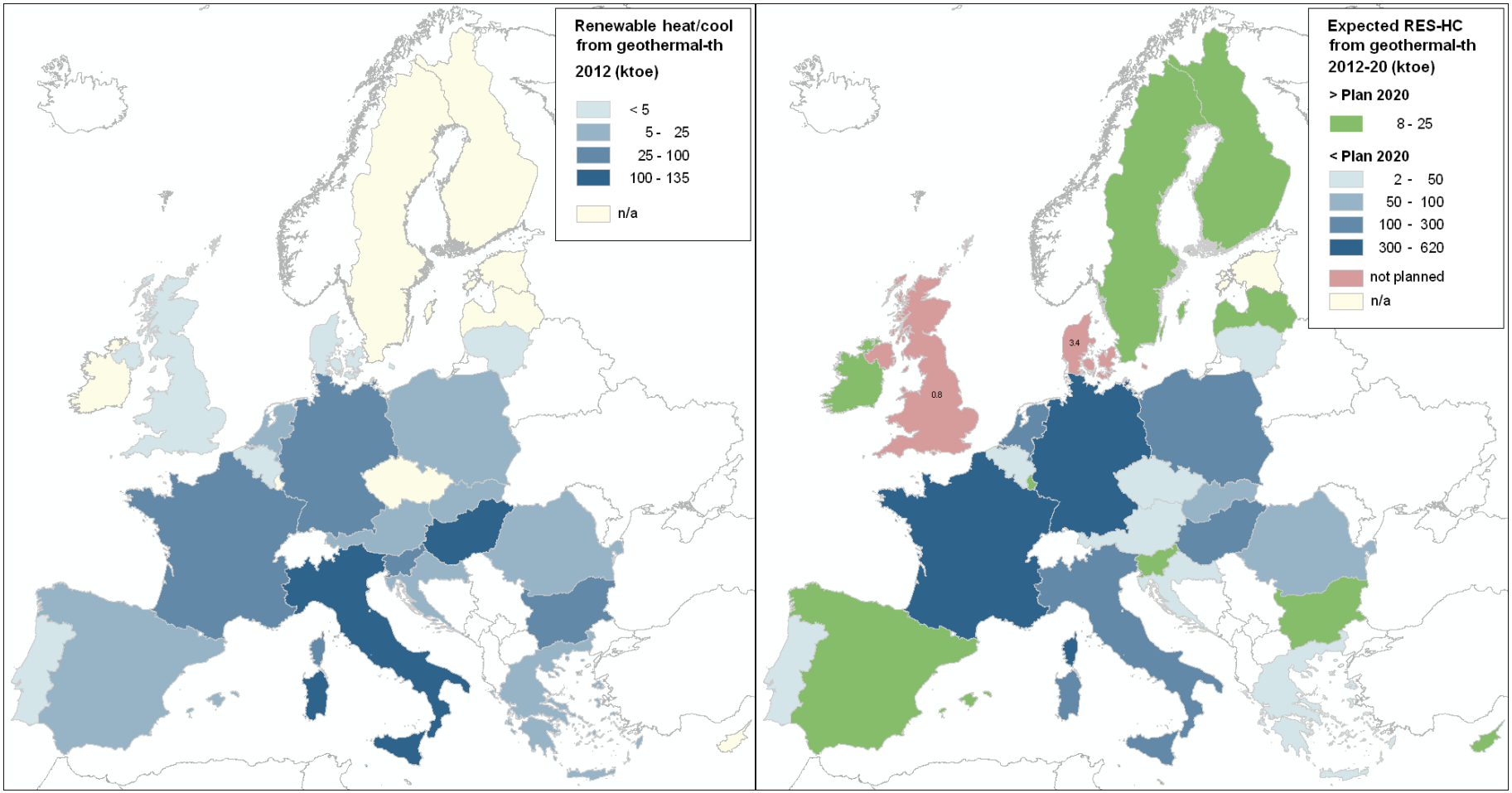

Figure 15. Renewable heat from geothermal technology in each MS, 2012 (left) – gap to 2020 (right)

3. Marine

3.1 Installed Capacity

Marine technology contribution in total renewable electricity installed capacity in year 2012 reached 247.3 MW, which is only 7.3 MW above the baseline level. The CAGR of development of this technology during period 2005-2012 was 0.43%, lower than the expected one of 1.2% leading to a marine contribution of 0.08% in total renewable electricity capacity for year 2012. The fastest development of this technology took place between 2011 and 2012 with a CAGR of 1.8% (+4.3 MW) compared with only 0.2% during 2005-2010 and 2010-2011 periods. The expected development up to 2020 planned value of 2253 MW is expected to take place with a CAGR of 31.8% (+2006 MW) with a contribution of 0.47% in total renewable electricity installed capacity.

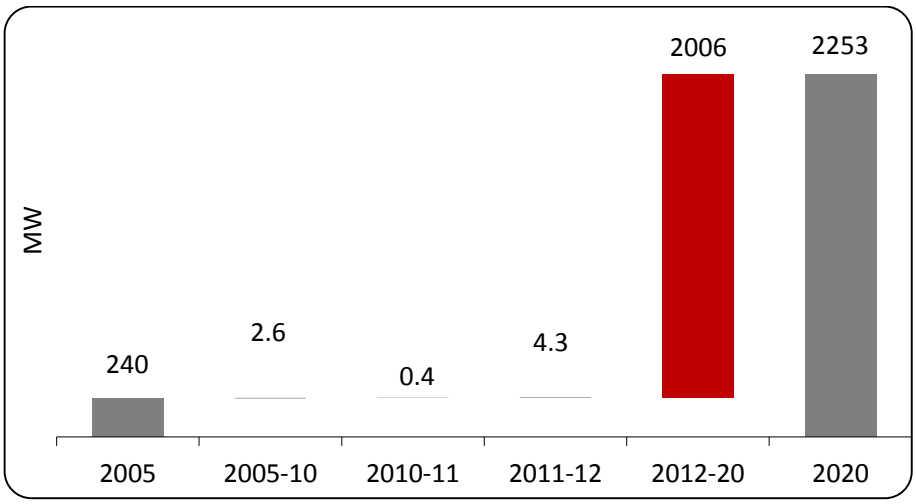

Figure 16. Marine installed capacity progress in the EU, 2005-2020

Only three Member States (FR, PT and UK) reported on this technology in year 2012. For the same year France had planned to increase its contribution in marine technology to 256 MW but in fact it kept the same level as in the baseline year. The contribution of Portugal was 93.4% lower than the expected level of 5 MW for the same year. United Kingdom had no plans to introduce marine technology before year 2016 but in year 2012 it reported an installed capacity of 7 MW.

In 2020 eight Member States (IE, ES, FR, IT, NL, PT, FI and UK) are expected to report on marine capacity. United Kingdom is expected to cover almost 58% of total marine installed capacity for year 2020 with an amount of 1300 MW and a CAGR of 92.1% in 2012-2020. Nevertheless, the fastest development is expected to take place in Portugal with a CAGR of 129% in order to reach the 2020 plan of 250 MW. The development of marine capacity in France will take place with a CAGR of 5.9% to reach the 2020 plan of 380 MW.

3.2 Contribution to renewable electricity

Renewable electricity coming from marine technology reached in 2012 the amount of 462 GWh (1.66 PJ), 13.6% (-73 GWh) lower than the baseline level of 535 GWh (1.9 PJ) showing an actual CAGR of -2.1% compared with the expected CAGR of +1%. In the same year the

relative contribution of this technology in the EU renewable electricity production was very marginal, 0.06%, missing the 2012 planned value by 19.7% (-113 GWh). Marine electricity production decreased in the overall 2005-2010 period with a CAGR of 2.2%, slightly increased between 2010 and 2011 by a CAGR of 0.04% and then decreased again between 2011 and 2012 with a CAGR of 3.3%. In order to reach the 2020 target of 6506 GWh (23.4 PJ), the future development of this technology is expected to be significant with a CAGR of 39.2% (+6044 GWh)

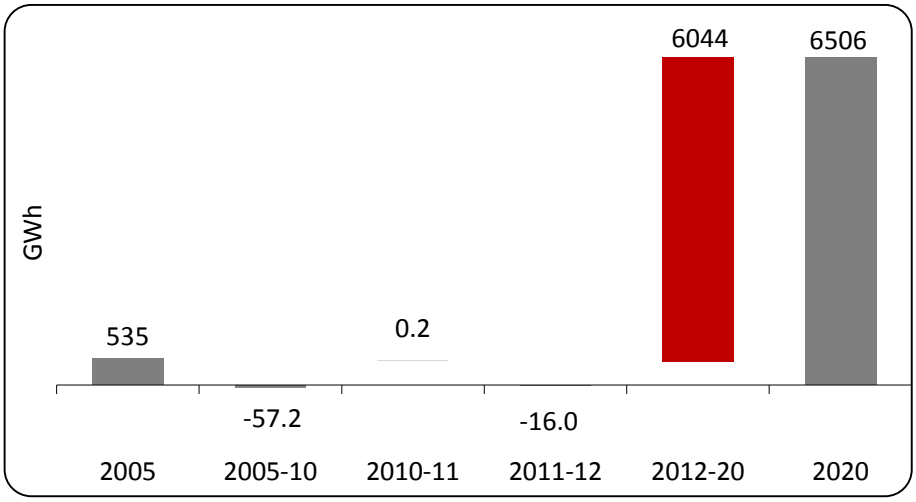

Figure 17. Marine renewable electricity progress in the EU, 2005-2020

France, Portugal and United Kingdom were contributing in this technology in year 2012. Despite the increase with a CAGR of 1% planned between 2005 and 2012 France reported in 2012 a level 77 GWh lower than the baseline value of 535 GWh (1.9 PJ).

The 2012 unplanned marine contribution of United Kingdom in its renewable electricity reached 4 GWh (0.014 PJ), which is nearly 1000 times smaller than the very ambitious 2020 plan level of 3950 GWh (14.2 PJ). The marine contribution to renewable electricity of Portugal reached only 0.003 GWh in 2012 being almost 100% below the expected level of 3 GWh (0.01 PJ).

In 2020 the number of Member States expected to have a contribution of marine technology in their final renewable energy will increase since IE, ES, IT and NL are expected to report on this technology. Finland has reported no contribution on renewable electricity for 2020 even that a capacity of 10 MW is expected for this year.

Almost 61% of renewable electricity coming from marine technology in 2020 is expected to be covered by United Kingdom that planned to develop this technology with a CAGR of 136.8% from the 2012 level. The development of the renewable electricity from marine technology in France from year 2012 is expected to take place with a CAGR pf 12.2% in order to reach the 2020 plan of 1150 GWh (4.14 PJ). Nevertheless, the fastest development is expected to take place in Portugal with a CARG of 342% to catch the 2020 plan of 437 GWh (1.6 PJ). The fastest development is expected to take place in Portugal with a CARG of 342% to catch the 2020 plan of 437 GWh (1.6 PJ).

4. Solar

Solar technology[8] (both solar-el and solar-th) provided in 2012 a contribution nearly 10 times higher than the baseline year figure of 816.4 ktoe (34.2 PJ), exceeding by 50% the 2012 NREAPs expected level of 5351 ktoe (224 PJ). The fastest development of this technology took place between 2010 and 2011 with a CAGR of 67.5% compared with the CAGR of 33.7% during period 2005-2010 and 37.4% between 2011 and 2012. In 2012 the share of solar technology increased from a quite marginal share of 0.8% in the baseline year, reaching 5.1%, noticeably higher than the expected share of 3.4%. The growth up to 2020 is expected to take place with a CAGR of +8.2% (+7114 ktoe or 298 PJ) in order to reach the 15152 ktoe (634.4 PJ) plan for this year. In 2020 the share of solar technology in total renewable energy is expected to increase up to 6.2%.

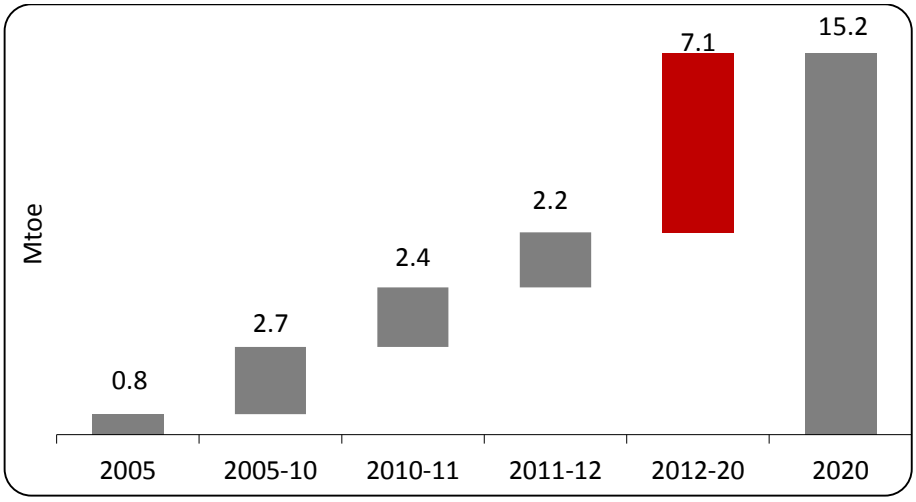

Figure 18. Marine renewable electricity progress in the EU, 2005-2020

The contribution of solar technology during period 2005 - 2012 in final renewable energy in the EU increased in all[9] Member States implementing it.

The leading Member States in year 2012 were Germany with 2844.7 ktoe (119 PJ) followed by Italy with 1777 ktoe (74.4 PJ), Spain with 1246.7 ktoe (52.2 PJ), France with 515.4 ktoe (21.6 PJ) and Greece with 330 ktoe (13.8 PJ).

Between 2005 and 2012 the development of this technology proceeded slower than planned in four Member States (CZ, ES, PL and PT). The development of this technology in Poland took place with a CAGR lower of what was expected, 81.7% (+83 ktoe) compared with 136.7% (+12.9 ktoe).
The fastest development took place in Croatia with a CAGR of 175% nevertheless resulting in the quite small absolute increase of +10.2 ktoe.

[8] Solar technology in this section includes both solar technology used in electricity sector (photovoltaics and Concentrated Solar Power) and solar technology used in heating/cooling sector.
[9] Only Estonia has no plans to introduce the contribution of solar technology (for electricity and heating/cooling) in final renewable energy up to 2020.

Compared with expected 2012 level based on NREAPs, eight Member States (CZ, ES, LV, LT, HU, PL, PT and RO) missed their plans while the highest positive deviations from NREAPs were found in Bulgaria with +485.2% (+70.5 ktoe), United Kingdom with +367% (+200.5 ktoe), Italy with +229% (+1237 ktoe), Slovakia with 192.4% (+27.3 ktoe) and Slovenia with +163.2% (+14.5 ktoe).

Although not planned, Finland introduced a contribution from this technology in final renewable energy for year 2012 reaching 1.4 ktoe (0.1 PJ).

The development of this technology in Bulgaria, Denmark, Sweden and United kingdom was faster enough to already exceed in 2012 the 2020 plan respectively by +57.4% (+26.6 ktoe) , with +83.4% (+13.6 ktoe), with +100% (+6.3 ktoe) and +12.6% (+28.5 ktoe).

Up to 2020 the fastest development is expected to take place in Romania with a CAGR of 82.6% (+96.7 ktoe) followed by Lithuania with a CAGR of 66.8% (+10.1 ktoe) and Poland with a CAGR of 57.9% (+493.2 ktoe).

In 2020, leading countries in solar energy are expected to be Germany with 4804.5 ktoe (201.2 PJ), Spain with 2943.2 ktoe (123.2 PJ), Italy with 2562 ktoe (107.3 PJ), France with 1519 ktoe (63.6 PJ) and Greece with 665 ktoe (27.8 PJ).

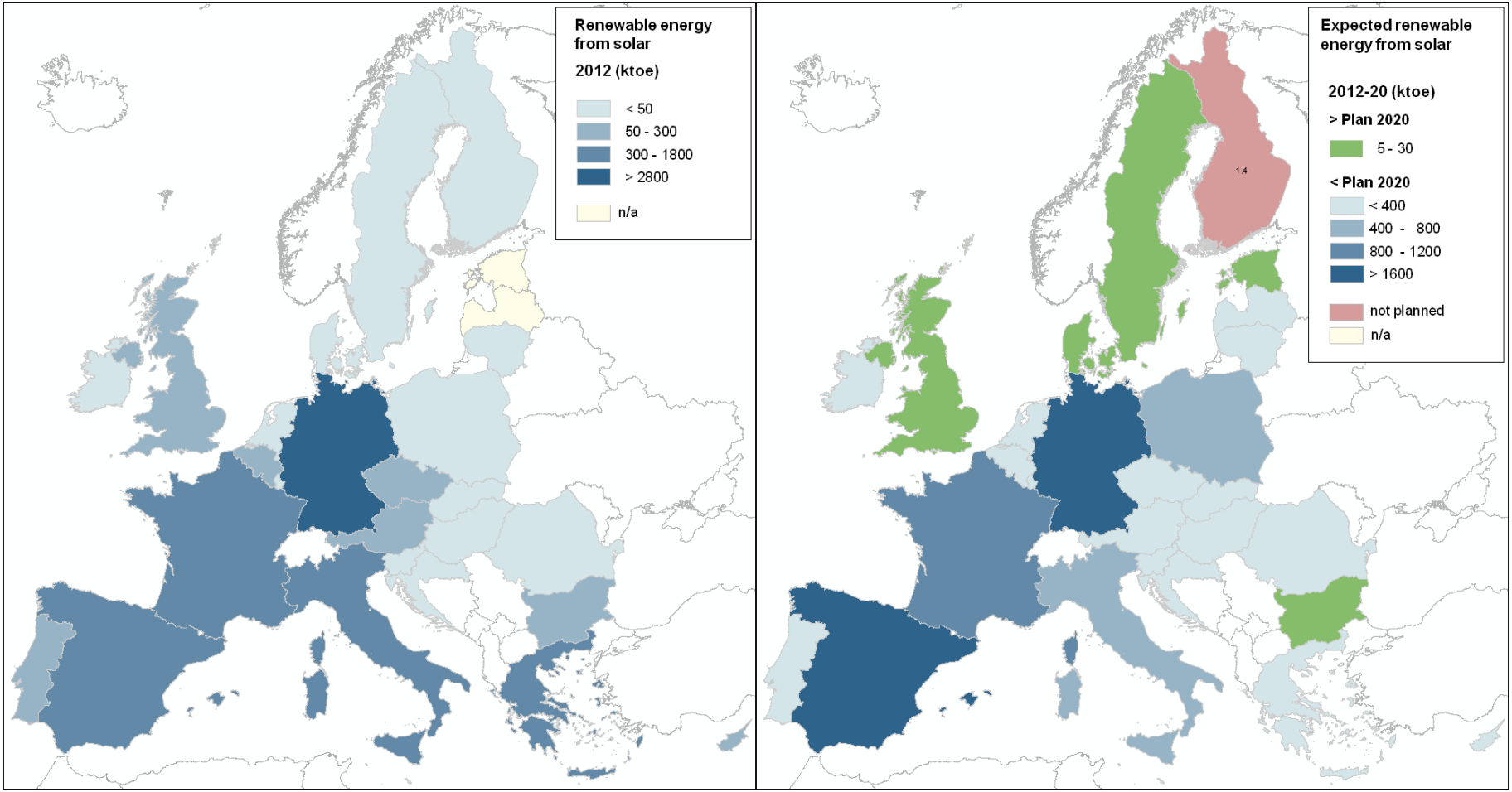

Figure 19. Renewable energy from solar technology (electricity + heating/cooling) in each EU MS, 2012 (left) – gap to 2020 (right)

4.1 Solar electricity

4.1.a. Installed Capacity

Between 2005 and 2012 solar electricity installed capacity in the EU increased with a CAGR of 64%, higher than the expected 51%, reaching the level of 70.8 GW from 2.2 GW in baseline year. The share of solar capacity in total renewable electricity installed capacity reached 22.7% in 2012, higher than the expected 13.7%. Photovoltaic capacity comprised 97% of total solar technology capacity in 2012. The fastest development of solar capacity took place between 2010 and 2011 with a CAGR of 34.6% compared with 2005-2010 and 2011-2012 respectively CAGR of 12.1% and 27.8%. Up to 2020 installed capacity of solar electricity technology is expected to be developed with a CAGR of 3.1% in order to reach the planned value of 90.5 GW and the share of 19% in total renewable electricity capacity.

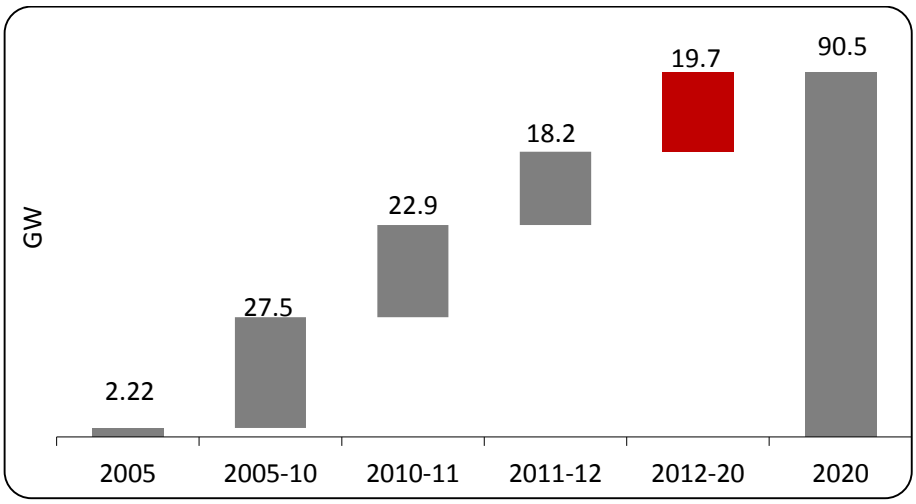

Figure 20. Solar installed capacity progress in the EU, 2005-2020

The development of installed capacity of solar electricity was very fast in eight Member States (BE, BG, DK, IT, AT, SI, SK and SE), which already exceeded the 2020 planned levels. The highest absolute exceedance from 2020 plan took place in Italy with 7.82 GW above the plans followed by Belgium with 1.24 GW above the plans and Bulgaria with 0.71 GW above the plans.

Although not planned, Ireland reported for year 2012 a small solar electricity installed capacity of 0.73 MW.

The fastest development since 2005 in solar electricity installed capacity took place in Czech Republic with a CAGR of 196.7% (+2021 MW) and in Greece with a CAGR of 185.2% (+1535 MW). The highest absolute additional capacity in solar electricity was registered in Germany with +30.66 GW and in Italy with +16.39 GW above the respective baseline levels of 1.98 GW and 0.034 GW.

The leading Member States in solar electricity capacity in 2012 were Germany with 32.64 GW, Italy with 16.42 GW, Spain with 6.6 GW, France with 4.1 GW and Czech Republic with 2 GW covering 87.2% of total renewable electricity capacity installed in this year.

Up to 2020 the largest absolute additional capacity is expected to be installed in Germany with +19.1 GW, Spain with +5.44 GW and France with +1.34 GW.

In 2020, the leading countries in solar power installed capacity are expected to be Germany with 51.75 GW, followed by Spain with 12.05 GW, Italy with 8.6 GW, France with 5.4 GW and the UK with 2.68 GW. The installed capacity of solar electricity in these five Member States should grow to 80.48 GW in 2020, representing ~89% of the solar electricity installed capacity in the EU-28 at that time.

4.1.b. Contribution to renewable electricity

Production of solar electricity increased in period 2005-12 with a CAGR of 74.2%, higher than the planned CAGR of 60.2%, and reached 71.42 TWh (257.1 PJ). This contribution accounted for 9.6% of total renewable electricity and 3.8% of final renewable energy in the EU in the same year, noticeably higher than the expected contributions of 5.3% and 2.2%. Photovoltaic share in total renewable electricity from solar technology reached 94.7% in 2012. The fastest development of solar electricity contribution took place during period 2010-2011 with a CAGR of 105% compared with the CAGR of 2005-2010 (73.6%) and 2011-2012 (50.1%). In 2020 solar technology is expected to contribute with 101.12 TWh (364 PJ) which in terms of share is translated to 8.4% in total renewable electricity and 3.5% in final renewable energy. In 2020 the share of photovoltaic in total renewable electricity from solar technology is expected to decrease to 81.2%

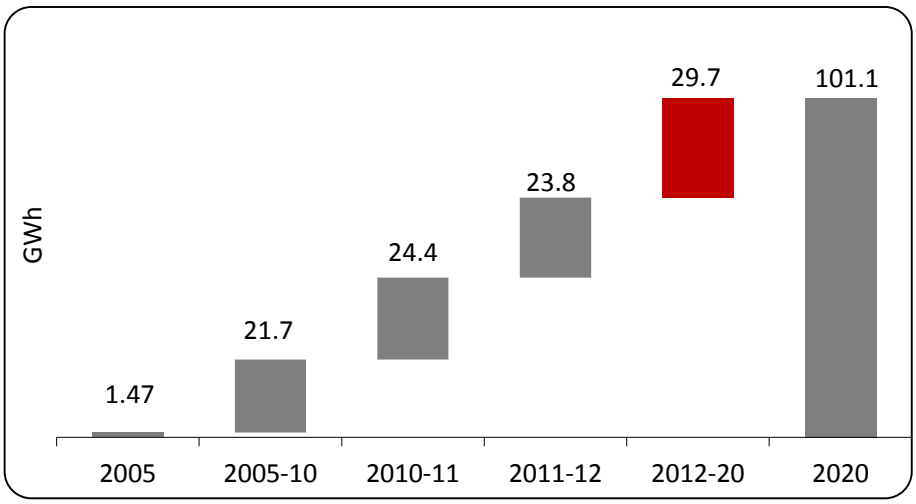

Figure 21. Solar renewable electricity progress in the EU, 2005-2020

Solar electricity increased in all[10] Member States during period 2005-12. Ireland reported in 2012 an unplanned solar electricity production of 0.5 GWh.

The fastest development between 2005 and 2012 in solar electricity took place in Belgium with a CAGR of 197.6% (+2.15 TWh) followed by Greece with a CAGR of 193.6% (+1.69 TWh) and Italy with a CAGR of 150% (+18.83 TWh).

[10] No contribution from Estonia is expected in renewable electricity coming from solar technology up to 2020.

Leading Member States in 2012 were Germany with 26.38 TWh (94.97 PJ), Italy with 18.86 TWh (67.9 PJ), Spain with 11.94 TWh (42.98 PJ), France with 4.45 TWh (16 PJ) and Czech Republic with 2.15 TWh (7.74 PJ), together contributing with 89% in total solar electricity in EU-28.

Malta had in 2012 the highest penetration of solar electricity, with 81.8% of total renewable electricity this Member States reached that year followed by Czech Republic with a share of 26.6%.

In 2020, leading countries in solar electricity production are expected to be Germany with 41.39 TWh (149.0 PJ), Spain with 26.74 TWh (96.2 PJ), Italy with 11.35 TWh (40.9 PJ), France with 6.89 TWh (24.8 PJ) and Greece with 3.6 TWh (13.0 PJ).

In 2020, the penetration of solar electricity in total renewable electricity mix is expected to reach 45.4% in Cyprus, 22.6% in Czech Republic 19.1% in Germany, 18.5% in Spain, and 12.4% in Greece.

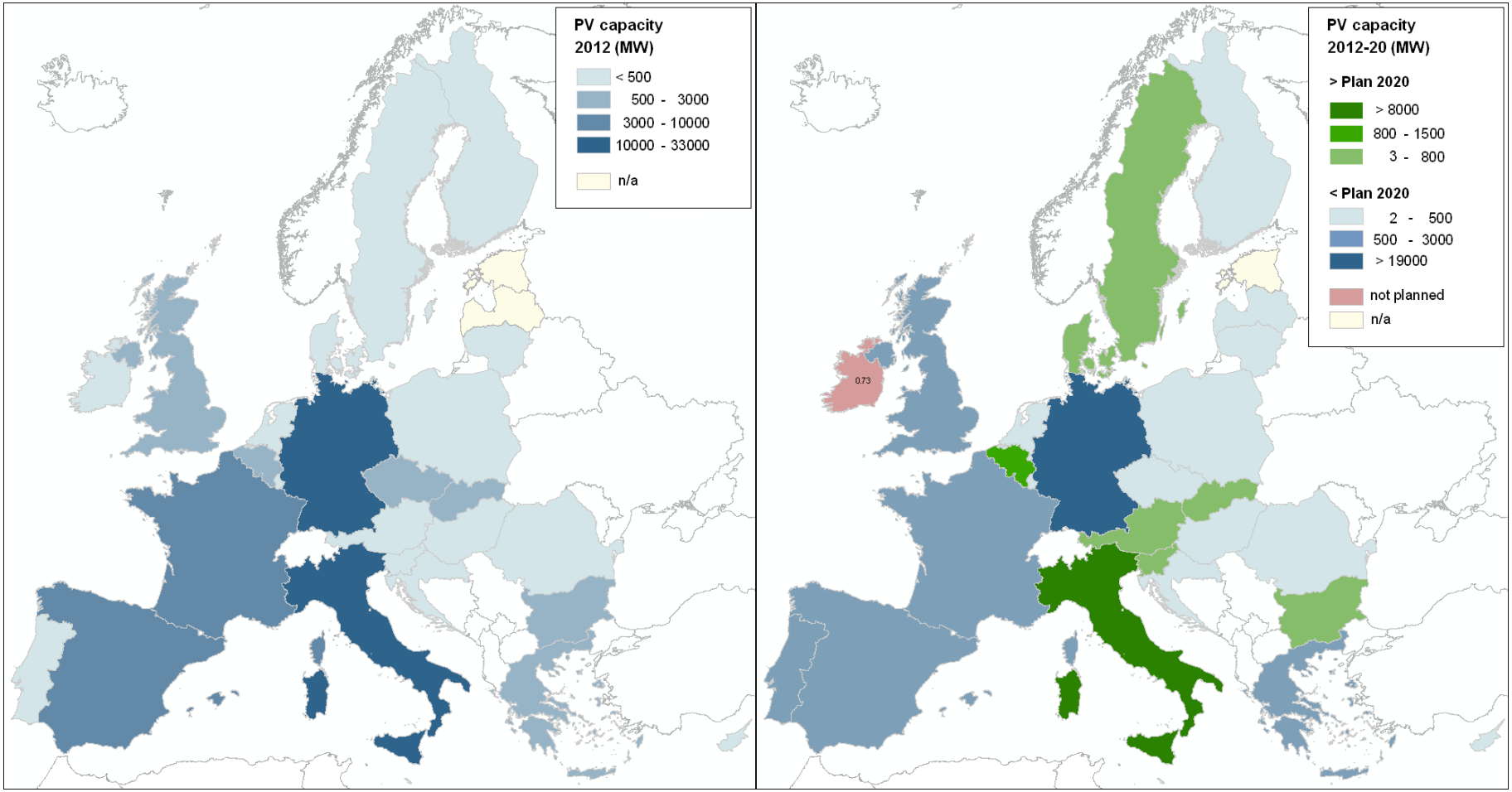

Figure 22. Photovoltaics installed capacity in each EU MS, 2012 (left) – gap to 2020 (right)

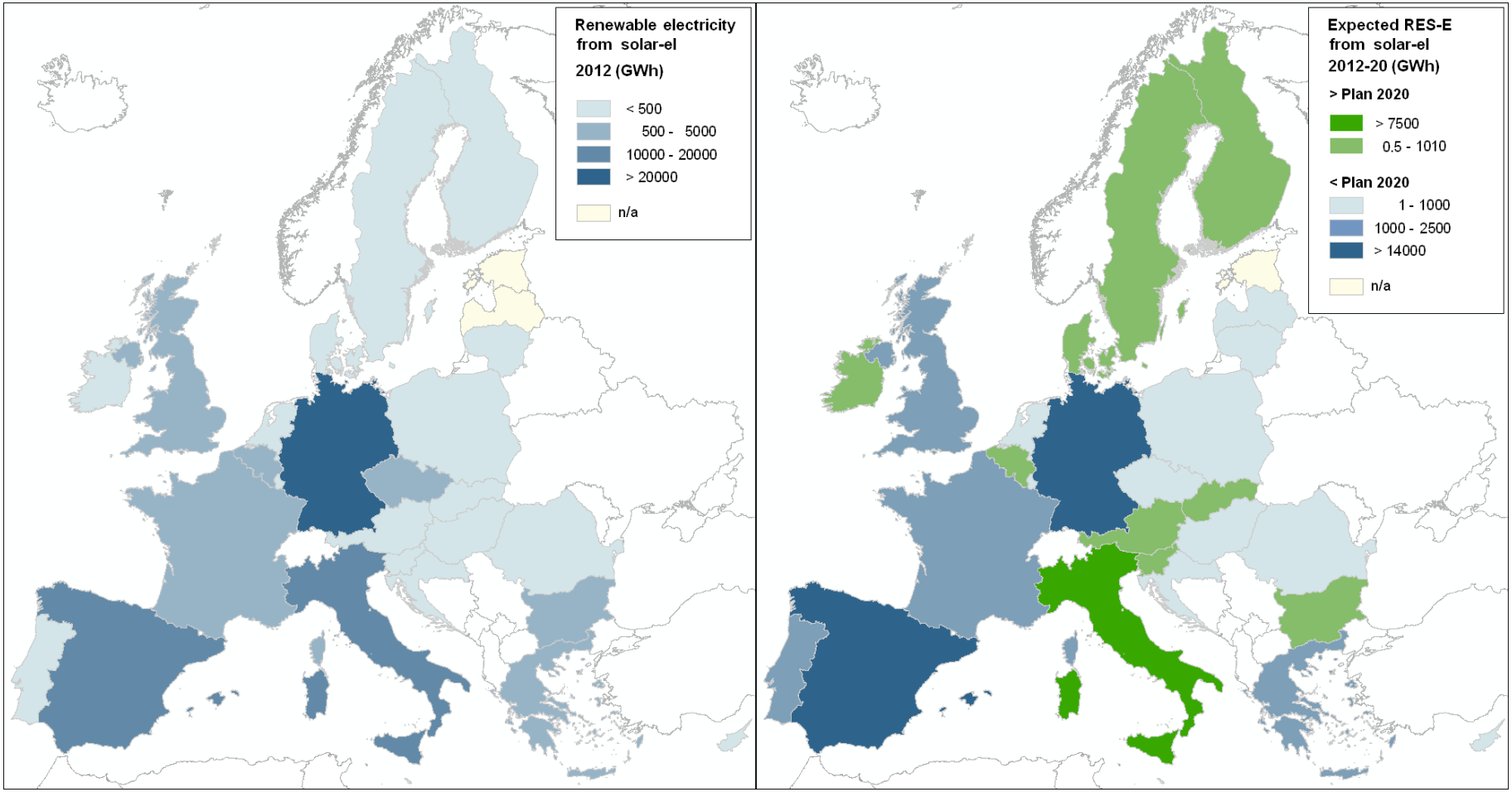

Figure 23. Renewable electricity from solar technology in each EU MS, 2012 (left) – gap to 2020 (right)

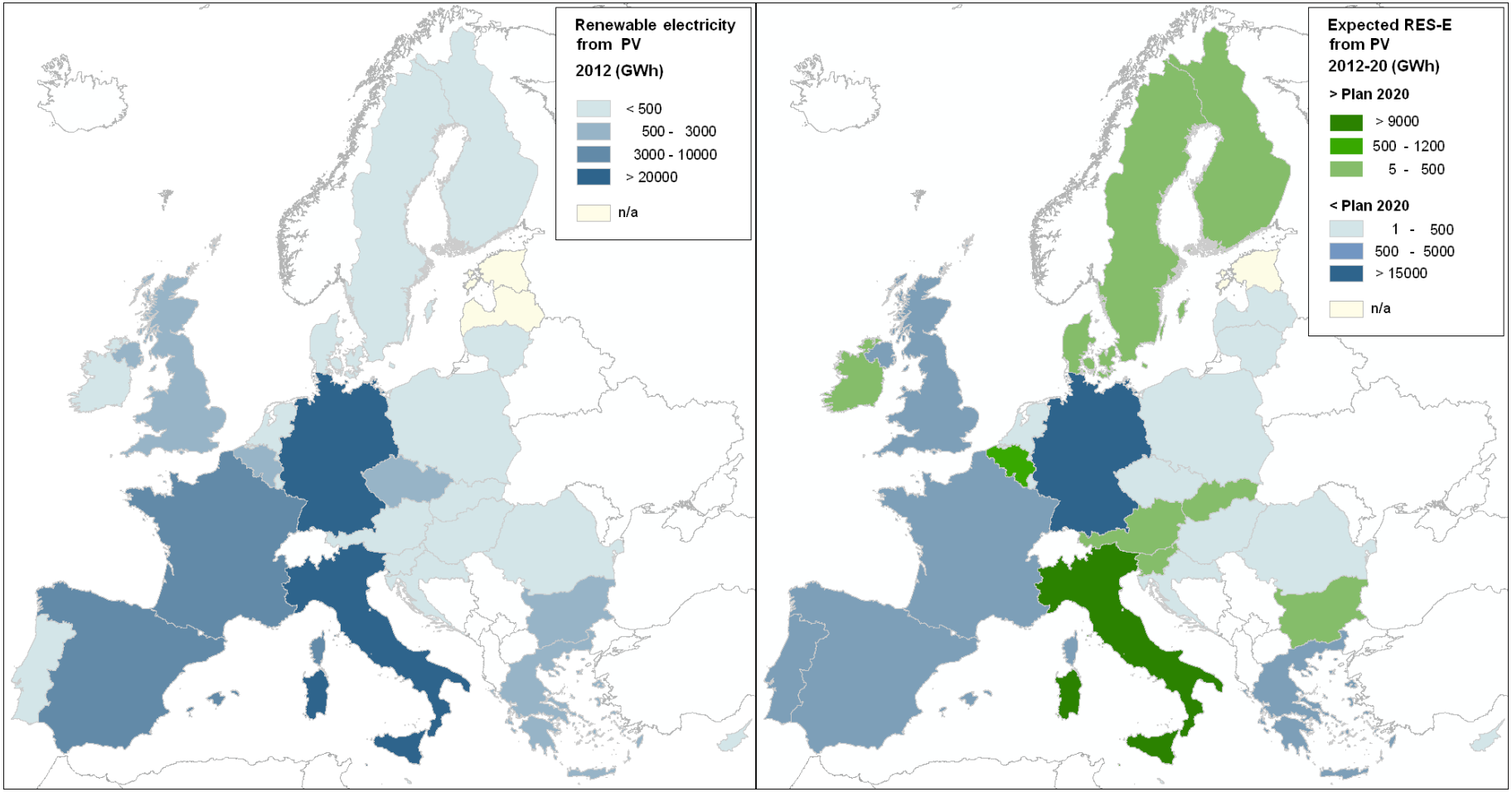

Figure 24. Renewable electricity from photovoltaics in each EU MS, 2012 (left) – gap to 2020 (right)

4.2 Solar heating/cooling

Solar in heating/cooling sector covered 2.3% of total renewable heat production in year 2012 reaching 1896 ktoe (79.4 PJ), starting from the baseline level of 690 ktoe (28.9 PJ). Its penetration in final renewable energy is still lower reaching in this year only 1.2% and missing the NREAPs planned contribution by 1.8% (-34 ktoe). Solar heating/cooling developed faster between 2010 and 2011 with a CAGR of 17.4% compared with period 2005-2010 (CAGR of 16.8%) and 2011-2012 (CAGR of 7.8%). Solar heating/cooling is expected to increase in 2020 its contribution by nearly 2.5 times in order to reach the planned value of 6455 ktoe (270.3 PJ). Up to 2020 the contribution of solar heating/cooling in final renewable energy is expected to double compare with 2012 level, reaching 2.64%.

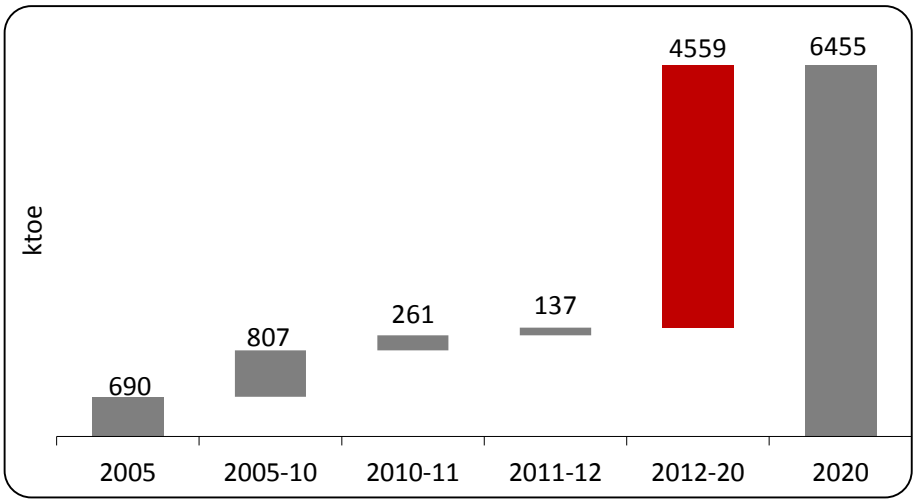

Figure 25. Solar renewable heating/cooling progress in the EU, 2005-2020

Between 2005 and 2012 five Member States (DK, MT, NL, SE and UK) developed solar heating faster than planned exceeding already the 2020 planned levels respectively by 31.3% (+5 ktoe), 40.6% (+1.12 ktoe), 13% (+3 ktoe), 83.3% (+5 ktoe) and 350% (+119 ktoe).

Even that according to its NREAP Finland had no plans to introduce this technology in heating/cooling sector it reported in 2011 a contribution of 1 ktoe.

Leading Member States in solar thermal technology in 2012 were Germany with 576 ktoe (24.12 PJ), Spain with 220 ktoe (9.21 PJ), Greece with 184 ktoe (7.7 PJ), Austria with 173 ktoe (7.24 PJ) and Italy with 155 ktoe (6.5 PJ) presenting 69.3% of total contribution coming from solar thermal technology.

The fastest development during period 2005-2012 took place in Poland with a CAGR of 81.5% (+13 ktoe) from the very low level of 0.2 ktoe in the baseline year.

In 2012, the highest penetration of this technology in renewable heat was registered in Cyprus with 79.1% followed by Malta with 57.9%, by United Kingdom with 12.53% and by Greece with 12.33%.
Up to 2020 the highest additional contribution from this technology is expected to take place in Italy which in 2012 reached 155 ktoe (6.5 PJ), one/tenth of its 2020 plan.

The fastest development up to 2020 is expected in Romania with a CAGR of 126.8% due to the fact that this Member States had in 2012 a very low contribution from solar thermal, only 0.1 ktoe when its 2020 plan is set to 70 ktoe (2.93 PJ).

In 2020 Italy is expected to be the leading Member State in solar thermal technology willing to reach 1586 ktoe (66.4 PJ) followed by Germany with 1245 ktoe (52.13 PJ), France with 927 ktoe (38.8 PJ), Spain with 644 ktoe (26.96 PJ) and Poland with 506 ktoe (21.2 PJ).
Cyprus and Malta will continue to maintain the highest penetration of solar thermal technology in total renewable heat even in 2020 with respectively 73.2% and 44.52%.

Belgium, Italy and Luxembourg are expecting a significant increase in the contribution of solar thermal technology in total renewable heat in 2020 respectively with 7.68%, 15.17% and 16.1% compared with 1.19%, 2.1% and 2.44% of contribution in 2012.

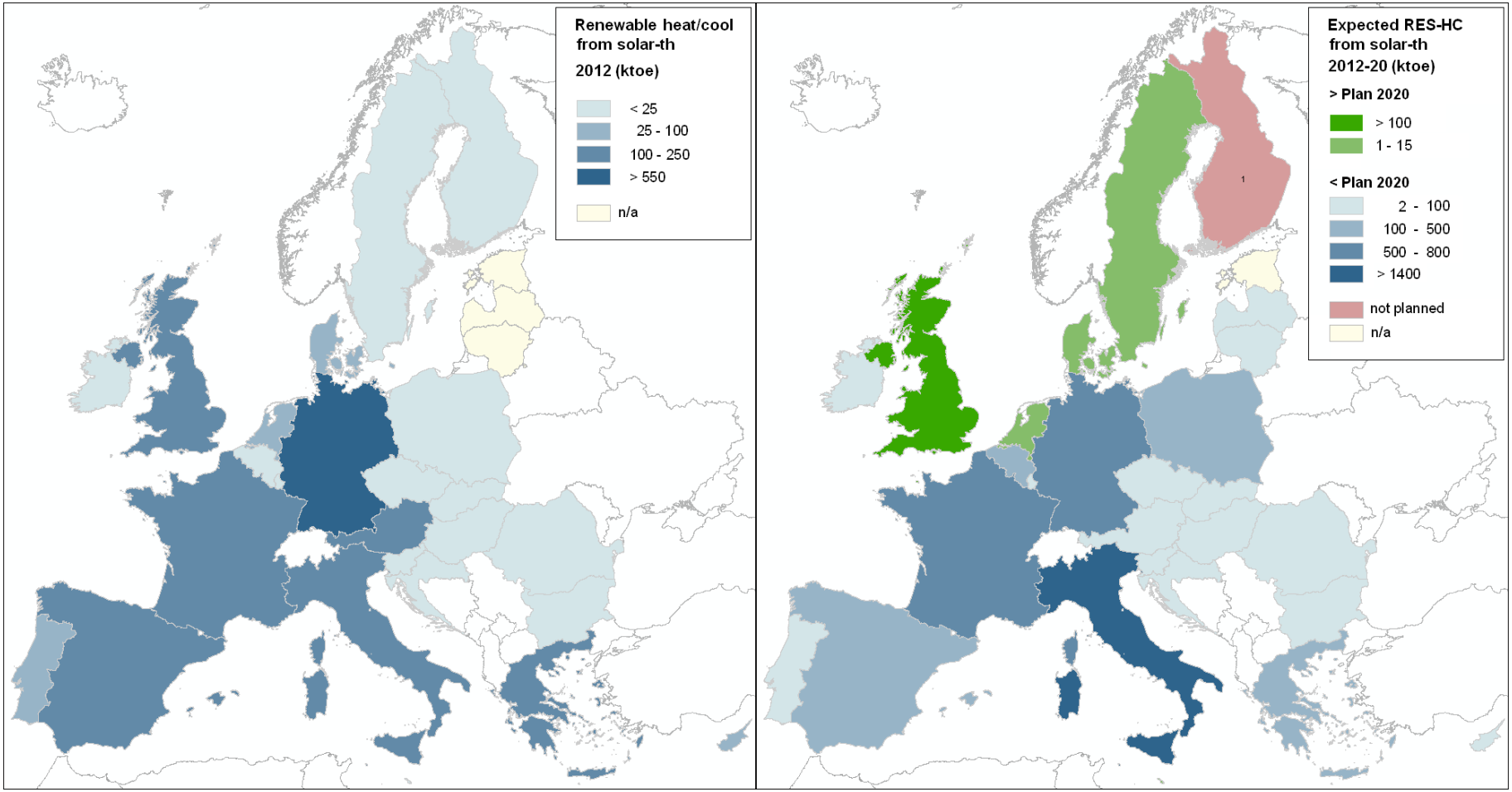

Figure 26. Renewable heat from solar technology in each EU MS, 2012 (left) – gap to 2020 (right)

5. Wind

5.a. Installed Capacity

Wind installed capacity in the EU amounted to 106.4 GW in 2012 increasing since 2005 with a CAGR of 14.8%, slightly lower than the planned one of 15.1%. In 2012 the contribution of wind technology in total renewable electricity capacity was 34.1% compared with 37% expected. The fastest development of wind capacity took place between 2005-2010 with a CAGR of 15.8% compared with CAGRs of period 2010-2011 (11.8%) and 2011-2012 (12.8%). Up to 2020 the EU will need to double the 2012 wind installed capacity in order to reach the 2020 plan of 211 GW then expecting a CAGR of 9%. The share of wind power capacity in total renewable electricity capacity in 2020 will increase to almost 44.3% being the dominating renewable electricity source in that year.

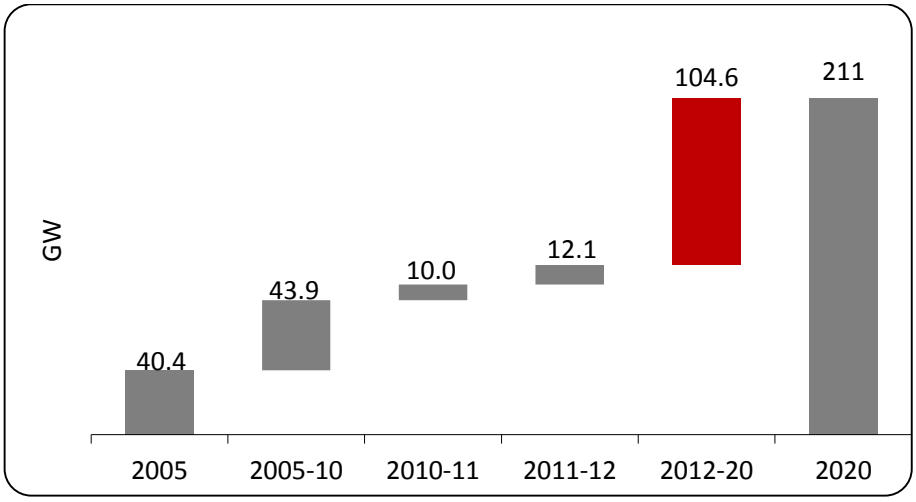

Figure 27. Wind installed capacity progress in the EU, 2005-2020

11 Member States (BE, CZ, DK, IT, CY, LV, LT, LU, PL, SE and UK) increased their wind capacity faster than planned during period 2005-2012. The development of wind capacity in Denmark took pace with a higher CAGR than planned (3.8% compared with 3% in the baseline year) exceeding already in 2012 the 2020 plan level of 3960 MW. Although the introduction of wind technology in Slovenia was planned to start in 2010, no wind capacity was reported even in the 2012 Slovenian progress report.

Slovakia has planned a development with a CAGR of 62.6% in wind capacity between 2005 and 2012 while in fact this development showed a negative CAGR equal to -7% reaching only 3 MW, i.e., 40% lower than the baseline level for this technology. Ireland had the highest penetration of wind capacity in total renewable electricity installed capacity in year 2012 with 85% followed by Cyprus with 84.4%, Estonia with 78% and Poland with 69%.

In 2020, the leading countries in wind power installed capacity are expected to be Germany with 45750 MW, followed by Spain with 35750 MW, the UK with 27880 MW, France with 25000 MW and Italy with 12680 MW. The installed capacity of wind plants in these five countries should reach 147060 MW in 2020, representing 69.8% of the wind plant capacity in the EU28 in that year.

5.b. Contribution to renewable electricity

In 2012 wind electricity reached 26.6% (198.53 TWh or 714.7 PJ) of renewable electricity developing with a CAGR of 16% from the baseline year, slightly lower than the planned one of 17.5%. Contribution of wind electricity developed faster between 2005 and 2010 with a CAGR of 17.1% compared with the CAGRs of period 2010-2011 (13.5%) and 2011-2012 (12.8%). For 2020 the electricity generation from wind power is projected to reach 488.08 TWh (1757 PJ) expecting a CAGR of 13.7%. Wind electricity is expected to become the dominant renewable electricity source, further increasing its contribution to 40.4%

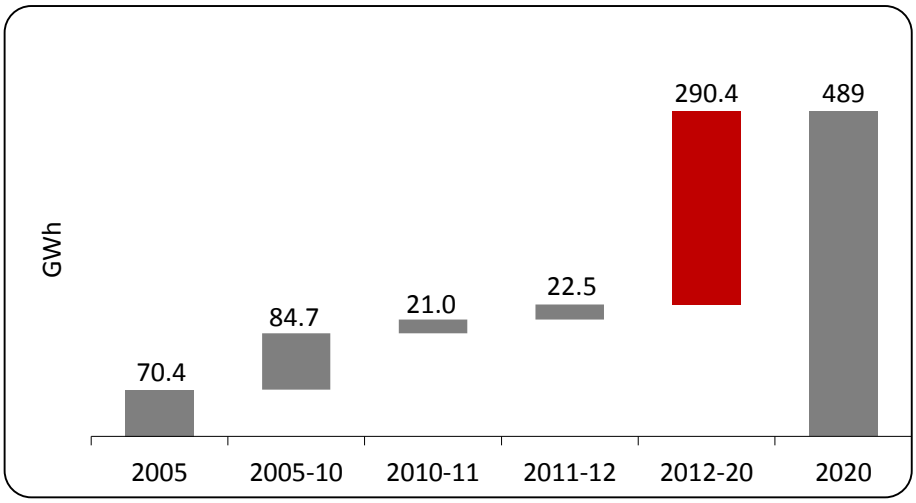

Figure 28. Wind renewable electricity progress in the EU, 2005-2020

In 2012 wind electricity generation developed slower than planned in 19 Member States (BE, BG, DK, DE, IE, GR, ES, FR, CY, LV, LU, HU, NL, AT, PT, RO, SI, FI and UK) compared with expected levels according to their respective NREAPs. From this group in 2012 Ireland, Greece, Netherlands and Finland reached only half of their planned generation. Although originally planned, in 2012 Malta and Slovenia did not report any contribution from wind electricity.

In relative terms, Romania showed the fastest development of wind electricity generation with a CAGR of 281% between 2005 and 2012, due also to the very low level in the baseline year, being nevertheless 20.2% (-671 GWh) below the expected level of 3316 GWh. Only 5 Member States (CZ, EE, IT, PL and SE) had a positive deviation from the expected NREAPs plans for year 2012. Slovakia had planned for period 2005-12 a development of wind technology with a CAGR of 50% but in fact the wind contribution resulted even below the baseline level, reaching only 6 GWh (0.02 PJ) in 2012 with a 95% (-114 GWh) negative deviation from the plan.

Leading Member States in wind electricity generation in 2012 were Germany, Spain, United Kingdom and Italy which accounted for nearly 72% of total wind electricity generated in EU-28. In 2020, leading countries in wind electricity production are expected to be Germany with 104.4 TWh (376.0 PJ), United Kingdom with 78.3 TWh (281.8 PJ), Spain with 72.6 TWh (261.2 PJ), France with 57.9 TWh (208.4 PJ) and the Netherlands with 32.4 TWh (116.7 PJ).

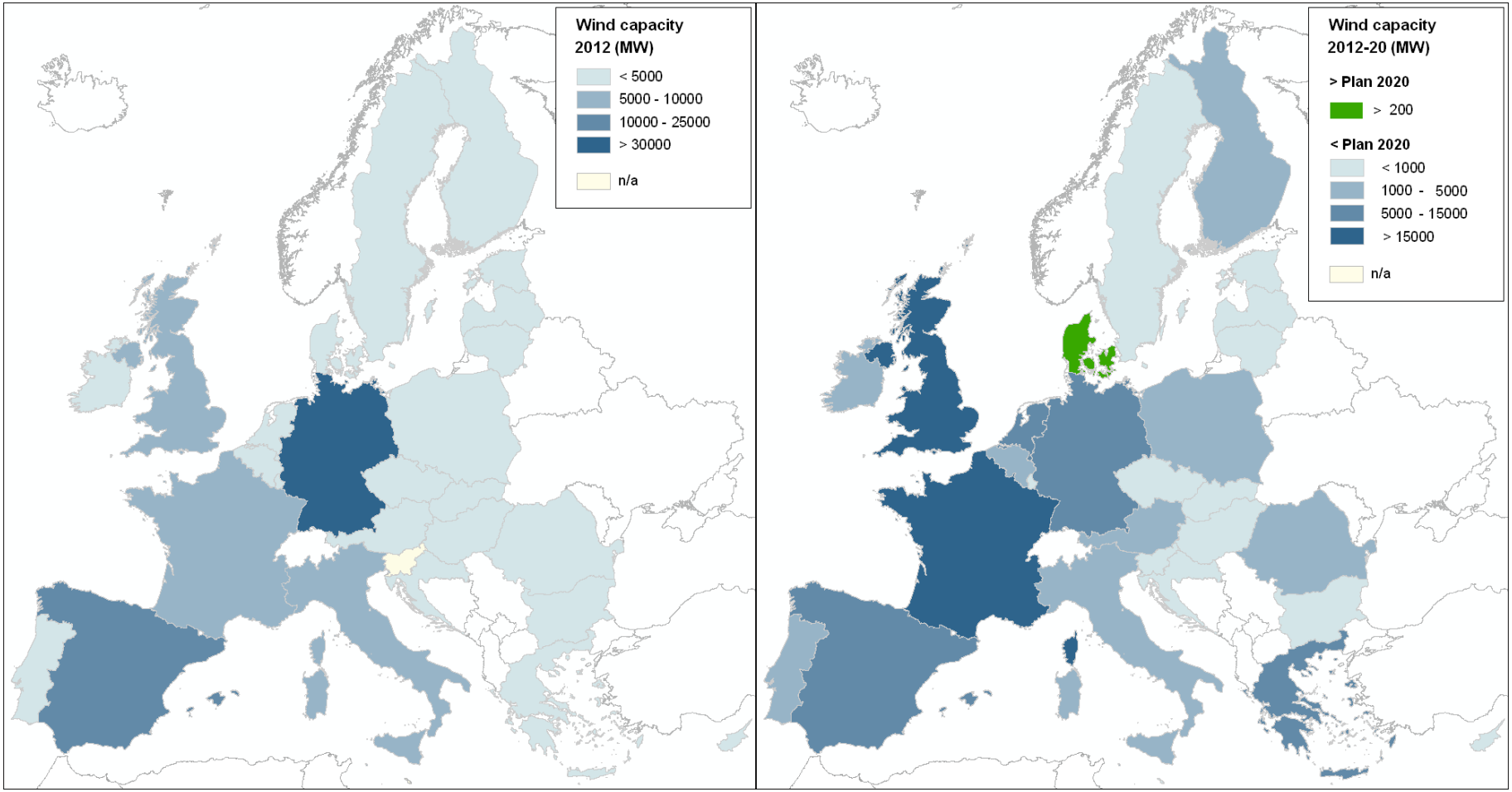

Figure 29. Wind power installed capacity in each EU MS, 2012 (left) – gap to 2020 (right)

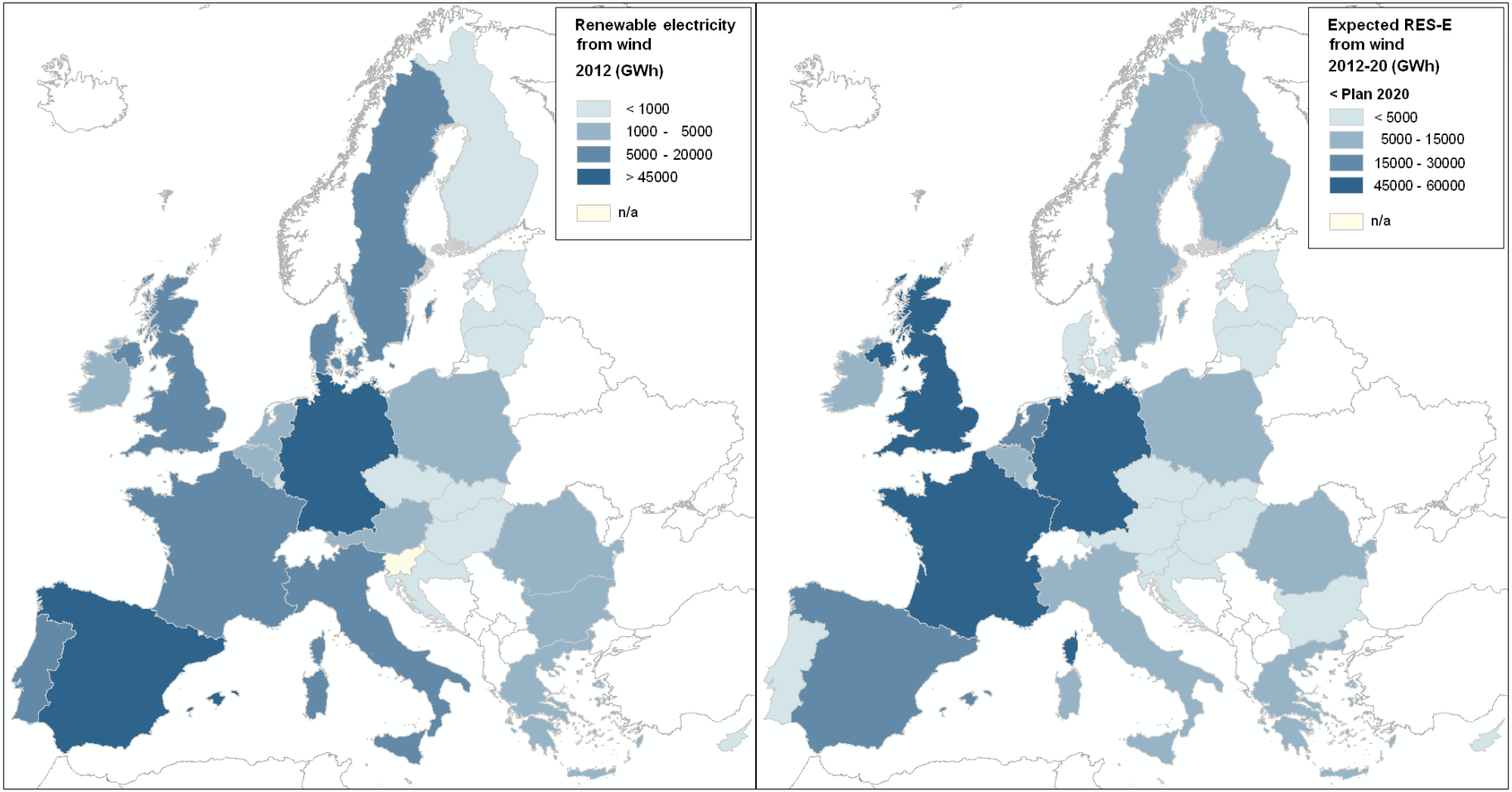

Figure 30. Renewable electricity from wind technology in each EU MS, 2012 (left) – gap to 2020 (right)

5.1 Onshore wind

5.1.a. Installed Capacity

Onshore wind installed capacity reached 101.2 GW[11] in year 2012 accounting for 95% of the total wind capacity installed in the EU. Onshore wind capacity increased by 11.7% between 2011 and 2012 and its share in total renewable electricity capacity reached 32.4% in 2012. Onshore wind capacity developed faster between 2005 and 2010 with a CAGR of 15.8% compared with the CAGRs of periods 2010-2011 (10.2%) and 2011-2012 (12.8%).

The share of onshore wind in total renewable electricity is expected to be increased up to 35.5% in 2020 while the relative contribution in total wind capacity will be decreased to 80.1%. In 2020 the EU is expecting to have installed 169 GW of onshore wind.

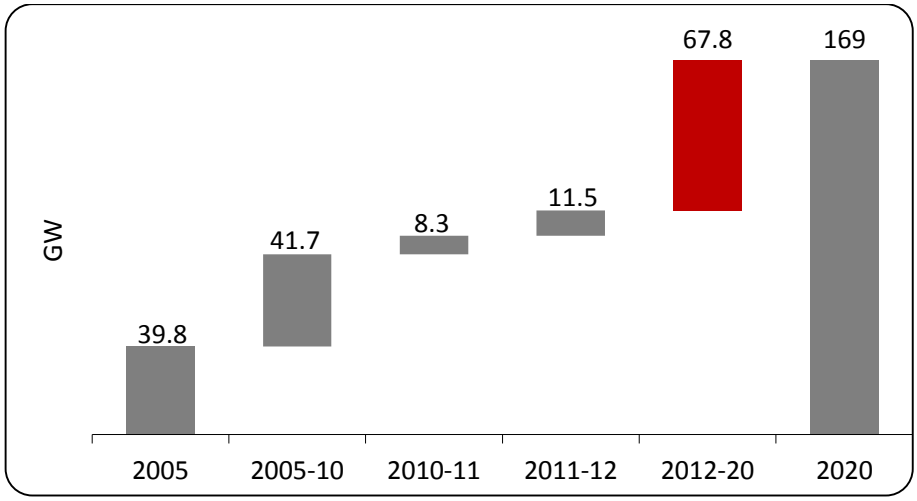

Figure 31. Onshore wind installed capacity progress in the EU, 2005-2020

The development of onshore wind in 2012 was slower than planned in 14 Member States (BG, EE, IE, EL, ES, HU, MT, NL, AT, PT, RO, SI, SK and UK) while Finland reported an unplanned capacity of 255 MW in the same year.

In 2012 the five leading Member States in onshore wind accounted for 74.4% of total onshore wind capacity in EU-28: Germany with 30.86 GW, Spain with 22.77 GW, Italy with 8.1 GW, France with 7.62 GW and United Kingdom with 5.89 GW.
In 2020, the leading countries in onshore wind power installed capacity are expected to be Germany with 35.75 GW, followed by Spain with 35.0 GW, France with 19.0 GW, United Kingdom with 14.8 GW and Italy with 12.0 GW. The installed capacity of onshore wind

[11] Belgium and Lithuania didn't report on subcategories of wind technology for period 2011-12. According to EWEA in 2011-12 offshore wind capacity in Belgium reached respectively 195 MW and 380 MW resulting then in a capacity of 874 MW and 984 MW for wind onshore (Belgium reported a total wind installed capacity of 1069 MW in 2011 and 1364 MW in 2012). The contribution of Belgium is inserted in the calculation of total wind capacity in EU-28 and in the penetration of this subcategory in total renewable electricity and total wind capacities for period 2011-12. For Lithuania the reporting figure for wind installed capacity is considered as being fully onshore (in line with Lithuania NREAP) with a contribution of 202 MW in 2011 and 275 MW in 2012. Data reported in the Annex on this wind subcategory doesn't include the EWEA data.

plants in these five countries should increase to 116.64 GW in 2020, representing 69% of the onshore wind plant capacity in the EU-28 in that year.

3.5.1.b. Contribution to renewable electricity

In 2012 renewable electricity originated from onshore wind reached 181 TWh[12] increasing by 11.8% (+19.1 TWh) from 2011 level. Its share in total wind power reached 91.2%, slightly higher than the expected one, 90.9%. Nevertheless, its contribution in final renewable electricity was slightly lower than expected reaching 24.2% instead of the expected 24.6%. The fastest development of onshore wind contribution to renewable electricity took place between 2005-2010 with a CAGR of 17.4% compared with GAGRs of period 2010-2011 (8.9%) and 2011-2012 (11.6%). The electricity generation from onshore wind power is projected to reach 352.4 TWh (1268.7 PJ) in 2020 with a contribution of 29% in renewable electricity.

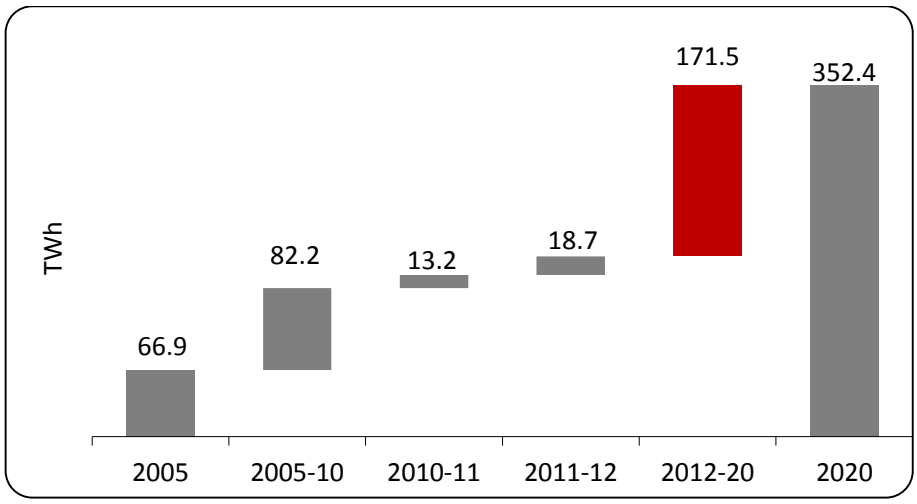

Figure 32. Onshore wind renewable electricity progress in the EU, 2005-2020

Germany with 49.3 TWh and Spain with 47.6 TWh were the leading Member States in 2012 accounting for nearly 54% of total renewable electricity originated from onshore wind. France, Italy and United Kingdom were part of five Member States with higher onshore wind electricity with respectively 14.2 TWh, 12.4 TWh and 11.7 TWh.

In 2020, leading Member States in onshore wind power production are expected to be still Germany with 72.7 TWh (261.6 PJ) and Spain with 70.7 TWh (254.6 PJ) but their relative contribution in the EU onshore wind power will decrease to 40.8%. France, United Kingdom and Italy will complete the group of five leading countries with respectively 39.9 TWh (143.6 PJ), 34.1 TWh (123 PJ) and 18.0 TWh (64.8 PJ). The electricity generated from onshore wind plants in these five countries should increase to 235.5 TWh (847.6 PJ) in 2020, representing 67% of the onshore wind electricity generation in the EU. In 2020, the highest shares of

[12] For Lithuania the reporting figure for renewable electricity originated from wind is considered as onshore wind (in line with Lithuania NREAP) with a contribution of 409 GWh in 2011 and 562 GWh in 2012.
Belgium contributes in renewable electricity production for onshore wind is missing and no other sources are used to substitute the non-reported figures for 2011 and 2012.

onshore wind power in total renewable electricity are expected in Ireland with 73.5%, Greece with 55.6%, Estonia with 51%, Spain with 48.8% and Cyprus with 42.2%.

5.2 Offshore wind

5.2.a. Installed Capacity

Offshore wind installed capacity in the EU reached 3652 MW in 2011 and 5251 MW[13] in 2012. Its contribution in total wind installed capacity reached in 2012 the share of 4.8% compared with the expected one 5.3%. Its contribution in total renewable electricity installed capacity was expected to reach 2% in 2012 but in fact it was found to be 0.4pp lower. Offshore wind capacity developed faster between 2011 and 2012 with a CAGR of 49% comparing with periods 2005-2010 (CAGR of 33.5%) and 2010-2011 (CAGR of 19.3%). In 2020 the offshore wind installed capacity needs to make significant progresses to reach the planned 41.97 GW and the planned share of 8.8% in the total renewable electricity capacity.

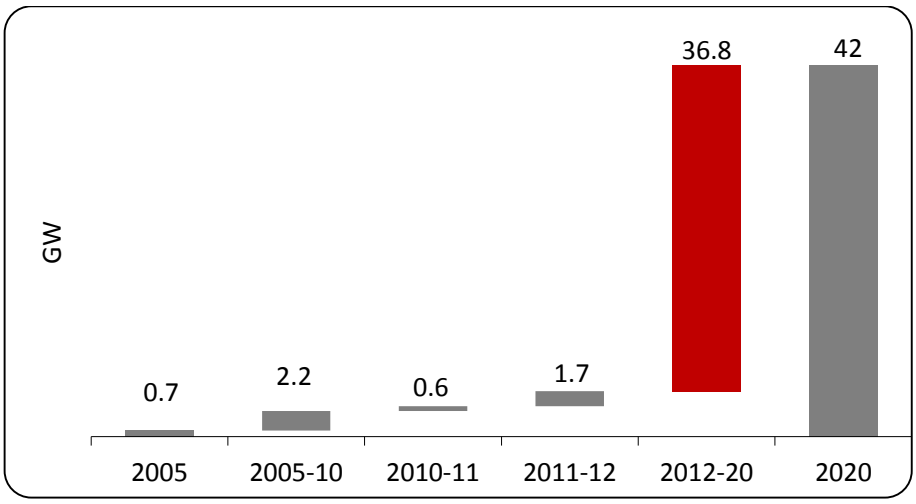

Figure 33. Offshore wind installed capacity progress in the EU, 2005-2020

United Kingdom owns 58% (2995 MW) of offshore wind capacity in the EU for year 2012. For the same year Denmark and Germany have reported respectively 922 MW and 435 MW installed capacity.

In 2020, United Kingdom is still expected to be the leading Member State in offshore wind power installed capacity with almost 13 GW, followed by Germany with 10.0 GW, France with 6.0 GW, the Netherlands with 5.2 GW and Belgium with 2.0 GW. The installed capacity of offshore wind plants in these five countries should increase to 36.2 GW in 2020, representing 86.2% of the offshore wind plant capacity in the EU.

3.5.2.b. Contribution to renewable electricity

Offshore wind electricity in the EU reached 10.23 TWh[14] (36.8 PJ) in 2012 increasing annually by 26% compared with the baseline year. Although offshore developed faster than

[13] See Footnote 12 on offshore wind capacity in 2012.
[14] Belgium contributes in renewable electricity production for offshore wind is missing and no other sources are used to substitute the non-reported figures for 2011 and 2012.

onshore wind (+35.8%) between 2011 and 2012, its share in final renewable electricity in 2012 was 1.37pp lower than 2.52% expected according the aggregated NREAPs[15]. The electricity originated from offshore wind power is projected to reach 136.5 TWh (491.5 PJ) in 2020. Offshore wind share in RES electricity is expected to have a significant increase aiming to reach 11.3% until 2020. The share of offshore wind electricity in total wind electricity produced increased from 2.7% in 2005 to 5.2% in 2012 and this is expected to further increase to 28% until 2020.

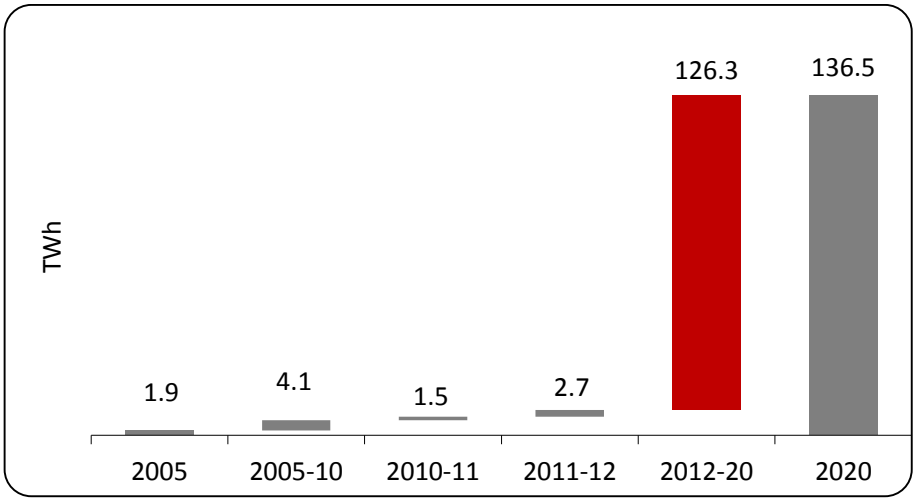

Figure 34. Offshore wind renewable electricity progress in the EU, 2005-2020

Only 4 Member States reported on offshore wind in year 2012: United Kingdom with 6931 GWh (25 PJ), Denmark with 2062 GWh (7.4 PJ), The Netherlands with 782 GWh (2.8 PJ) and Sweden with 460 GWh (1.7 PJ). United Kingdom had in 2012 the highest share of offshore wind power in final renewable electricity with 17.2%.

In 2020, leading Member States in offshore wind power are expected to be United Kingdom with 44.1 TWh (158.8 PJ), Germany with 31.8 TWh (114.4 PJ), The Netherlands with 19.0 TWh (68.5 PJ), France with 18.0 TWh (64.8 PJ) and Belgium with 6.2 TWh (22.3 PJ). In 2020, the highest shares of offshore wind power in final renewable electricity is expected to be reached in Malta with 46.1%, The Netherlands with 37.8%, UK with 37.7%, Estonia with 29.4% and Belgium with 26.8% accounted altogether for 87.2% of the offshore wind electricity generation in the EU.

6. Heat pumps

Energy from heat pumps in the EU increased more than 11 times-fold between 2005 and 2012 reaching 6762 ktoe (283 PJ) compared with 597.9 ktoe (25 PJ) in the baseline year. In 2012 heat pumps contribution in final renewable energy in the EU reached 4.3% while the contribution in final heat/cold increased to 8.2% from the baseline year of 1%.

[15] IE has reported for 2005 only the total renewable electricity produced by wind without dividing it in sub-categories. For this reason the sum of onshore and offshore wind electricity shares in total wind electricity is not equal to 100%.

Heat pump contribution in renewable heat/cold developed faster between 2005 and 2010 with a CAGR of 48.8% compared with period 2010-2011 (CAGR of 40%) and 2011-2012 (CAGR of 10.7%).

For 2020 the heat/cold expected to come from heat pumps is projected to reach 12286 ktoe (514.4 PJ) and to cover 5% of final renewable energy, with a share in final renewable heat/cold generation of almost 11%.

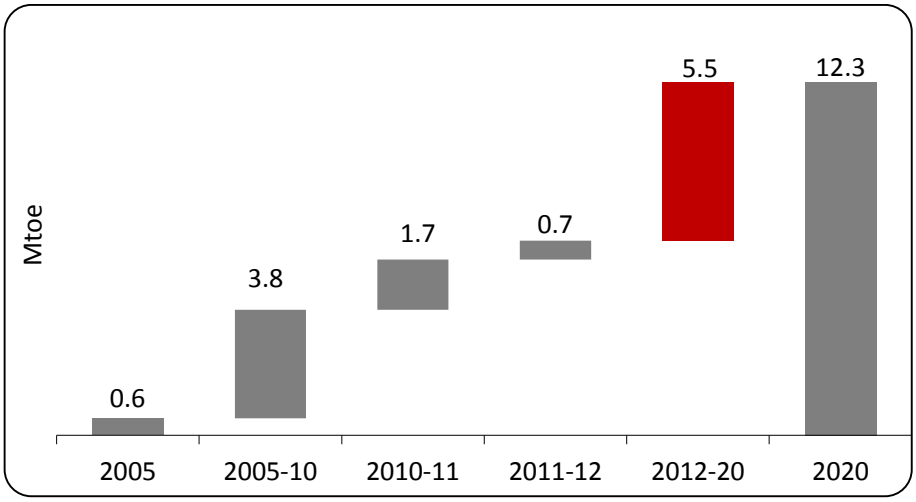

Figure 35. Heat pumps renewable heat/cold progress in the EU, 2005-2020

Heat pumps experienced the fastest development in Italy increasing 119 times-fold from the baseline year reaching 2613 ktoe (109.4 PJ) in 2012, almost 2 times the expected figure for this year according the Italy NREAP while France took the second place in 2012 reaching 1227 ktoe (51.4 PJ). These two Member States accounted for more than half (56.3%) of renewable heat/cold coming in the EU from heat pumps. Italy had also the highest penetration of this technology in its final renewable heat/cold with 35.4% followed by Malta with 26.3%.

In 2020, Italy is expected to maintain the leading position in heat/cold originated by heat pumps with 2900 ktoe (121.4 PJ) followed by United Kingdom with 2254 ktoe (94.4 PJ), France with 1850 ktoe (77.5 PJ), Germany with 1145 ktoe (47.9 PJ) and Sweden with 1045 ktoe (43.8 PJ). The first five countries will deliver about 9194 ktoe (384.9 PJ) of heat from heat pumps, representing about 75.7% of the heat generated from heat pumps in the whole EU. In 2020, leading countries in the share of heat/cold originated from heat pumps in final renewable heating/cooling will be United Kingdom with 36.4%, Italy with 29.0%, the Netherlands with 17.6%, Ireland with 13.5% and Denmark with 11.9%.

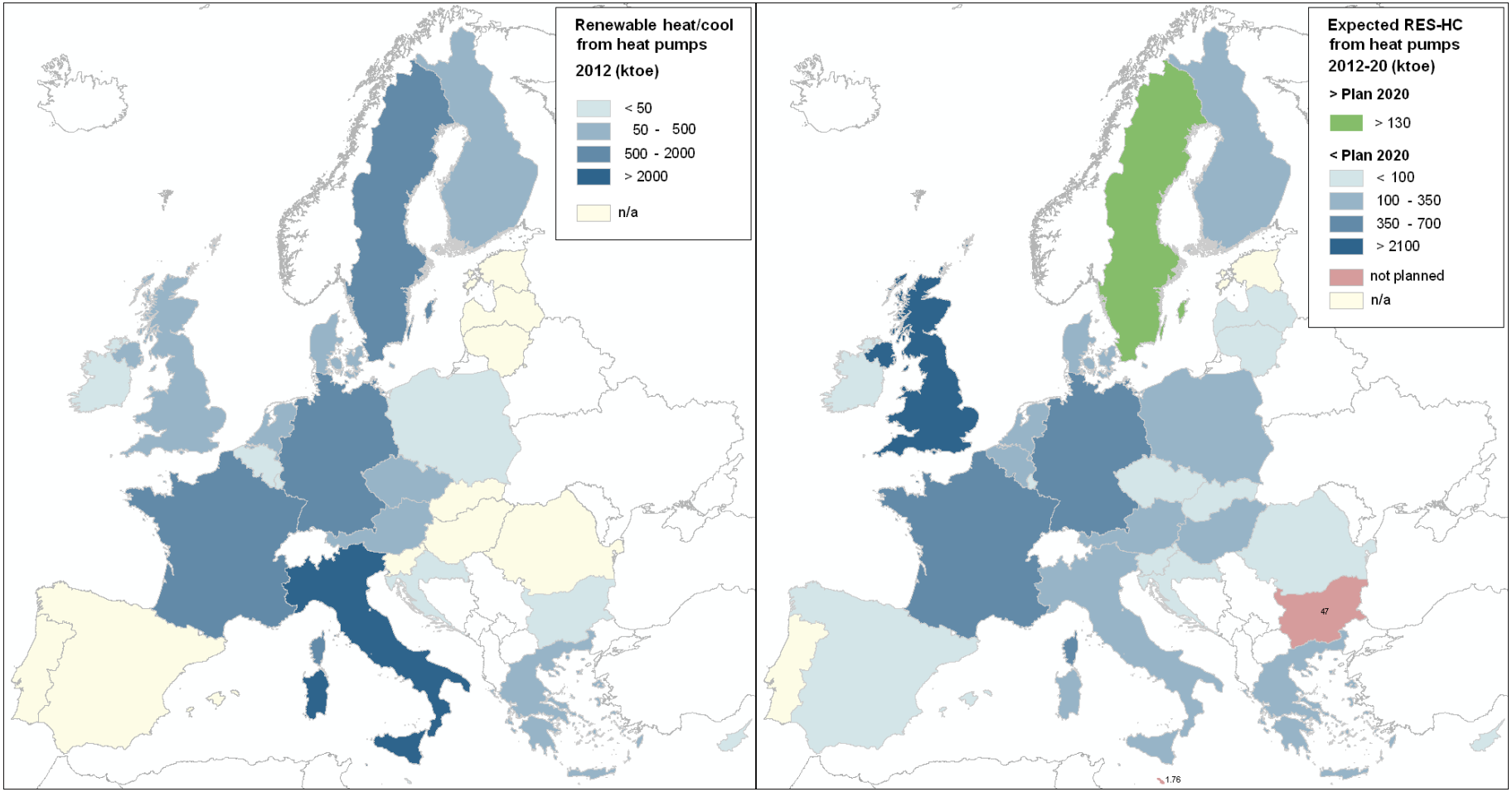

Figure 36. Renewable heat from heat pums in each EU MS, 2012 (left) – gap to 2020 (right)

7. Bioenergy

Bioenergy (including bioheat, bioelectricity and biofuels) use in the EU amounted to 97 Mtoe (4057 PJ) in 2012, increasing by 38.3% compared with the baseline figure of 62.1 Mtoe (2598.5 PJ). The share of bioenergy in the final renewable energy has slightly decreased from 62.4% in 2005 to 61.3% in 2012. Almost three-quarter of bioenergy was in the form of bioheat while bioelectricity and biofuels shared the rest with respectively 13.2% and 12.4%. The fastest development of bioenergy took place between 2005 and 2010 with a CAGR of 9.6% compared with period 2010-2011 (CAGR of -7.3%) and 2011-2012 (CAGR of 6.3%).
The bioenergy use is projected to increase up to 139.5 Mtoe (5841.4 PJ) in 2020, although its share in final renewable energy will decrease further to 57%. The share of bioheat in total bioenergy is expected to decrease to 64.8% whereas for bioelectricity and biofuels the respective shares are expected to reach 14.4% and 20.8%.

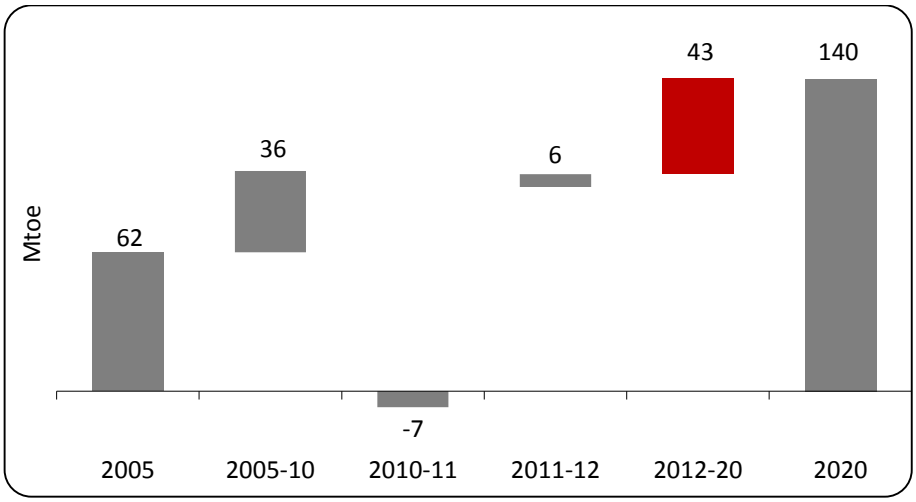

Figure 37. Bioenergy progress in the EU, 2005-2020

All Member States, except Portugal, increased their bioenergy use between 2005 and 2012. Comparing with their expected development, 11 Member States (CZ, DK, IE, EL, ES, FR, CY, MT, NL', PT and UK) were behind their plans for 2012. The fastest development compared with the baseline figures took place in Hungary where bioenergy developed with an average growth rate of 730% between 2005 and 2012. In 2012 the contribution of the five leading Member States (DE, FR, SE, FI and IT) in bioenergy accounted for more than 55% of bioenergy consumed in the EU in this year. Estonia had the highest penetration of bioenergy in final renewable energy in year 2012 with 94.3% followed by Lithuania with 92.1%, Poland with 91.4%, Hungary with 86.9% and Luxembourg with 83.6%.

In 2020, leading countries in bioenergy are expected to be France with 21.6 Mtoe (904.0 PJ), Germany with 21.1 Mtoe (882.6 PJ), Sweden with 11.7 Mtoe (491.6 PJ), United Kingdom with 10.4 Mtoe (434.1 PJ) and Italy with 9.8 Mtoe (410.9 PJ). In 2020, the highest shares of bioenergy in final renewable energy are expected to be reached in Lithuania with 88.0%, Estonia with 84.3%, Luxembourg with 83.8%, Czech Republic with 82.4% and Latvia with 81.8%.

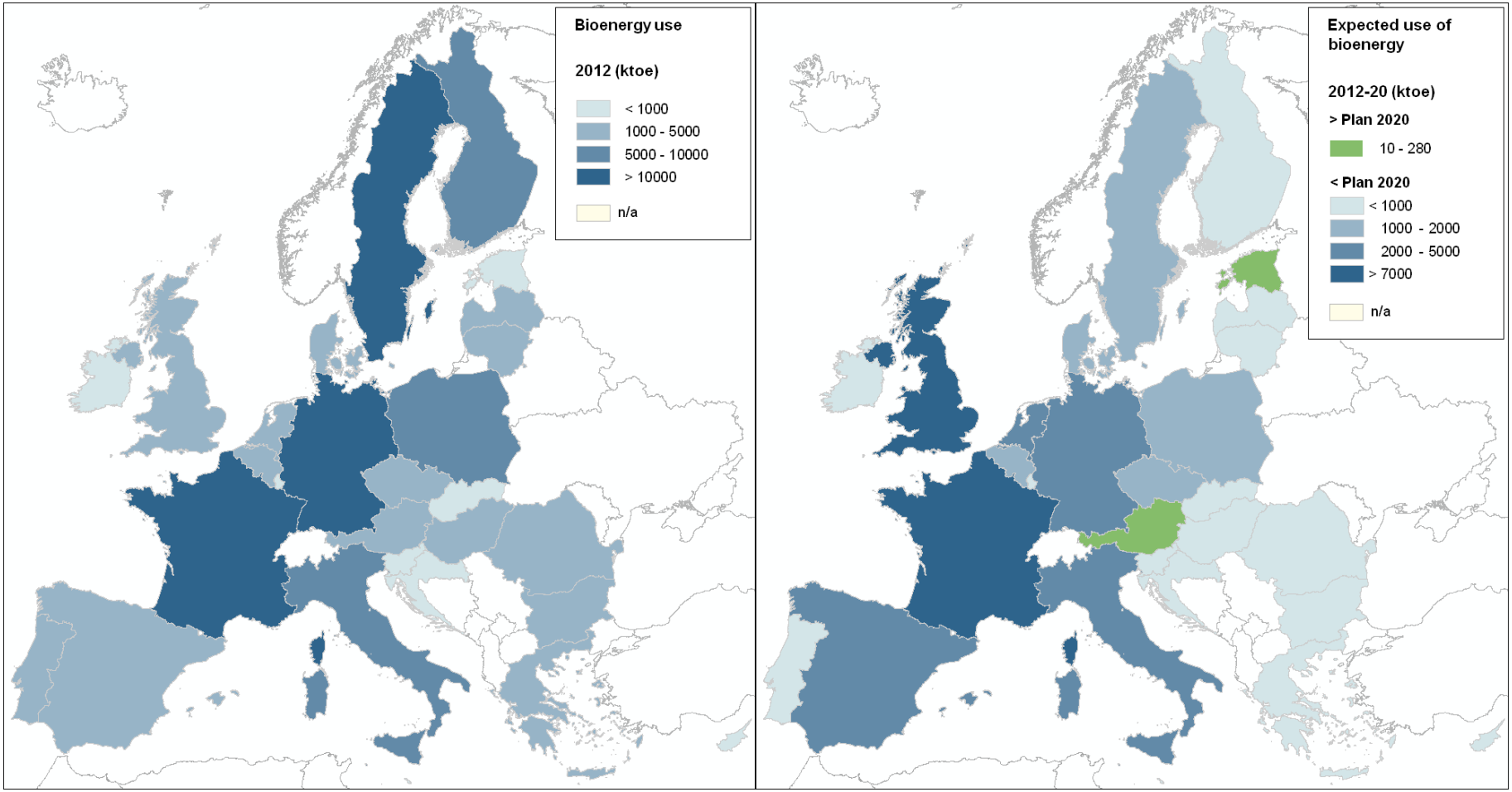

Figure 38. Renewable energy from bioenergy in each EU MS, 2012 (left) – gap to 2020 (right)

8. Biomass

Energy from biomass used in both electricity and heating/cooling in the EU reached 85 Mtoe (3557.3 PJ) in 2012 increasing with a CAGR of 5.3% between 2005 and 2012. Its share in final renewable energy reached 53.7% in 2012 starting from 59.2% in the baseline year. Bioheat was the dominating biomass category having in 2012 a share of 85.6% in total biomass used for energy purposes. The fastest development of biomass took place between 2005 and 2010 with a CAGR of 7.5% comparing with periods 2010-2011 (CAGR pf -6.3%) and 2011-2012 (CAGR of 6.7%). In 2020 the use of biomass for energy is expected to reach 110.5 Mtoe (4625 PJ) decreasing nevertheless to 45.1% its contribution to the expected final renewable energy in the EU. The ratio between bioelectricity and bioheat will change slightly in 2020: bioheat will account for 81.8% and bioelectricity for 18.2%.

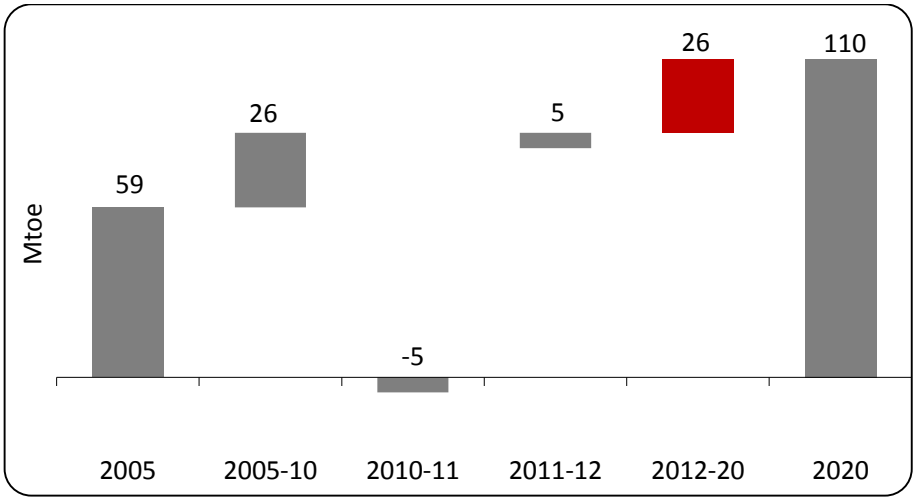

Figure 39. Biomass progress in the EU, 2005-2020

In 2012 only in the Netherlands (44.7% bioelectricity and 55.3% bioheat) and United Kingdom (56.7% bioelectricity and 43.3% bioheat) bioheat and bioelectricity almost equally shared the final use of biomass for energy purposes. In other Member States bioheat was the dominated form of biomass consumed for energy purposes. Leading Member States in biomass use for energy purposes in the EU in 2012 were Germany with 13.4 Mtoe (561.1 PJ), France with 10.8 Mtoe (452.2 PJ), Sweden with 9.5 Mtoe (398.6 PJ). In 2012 the highest share of biomass consumed for both electricity and heat/cold purposes in final renewable energy was found in Estonia (94.3%), Lithuania (86.6%), Finland (81.2%), Latvia (80.1%) and Hungary (77.6%).

In 2020 leading Member States in biomass for energy are expected to be France with 17.9 Mtoe (750.8 PJ), Germany with 15.6 Mtoe (653.5 PJ), Sweden with 10.9 Mtoe (457.7 PJ), Finland with 7.7 Mtoe (323.2 PJ) and Italy with 7.3 Mtoe (305 PJ). In 2020 bioelectricity is expected to be a dominating energy use of biomass only in Malta with 89% share. The highest share of biomass expected to be used for both electricity and heat/cold in final renewable energy in 2020 will be found in Latvia (78%), Lithuania (76.6%), Estonia (74%), Finland (72.2%) and Denmark (67.3%).

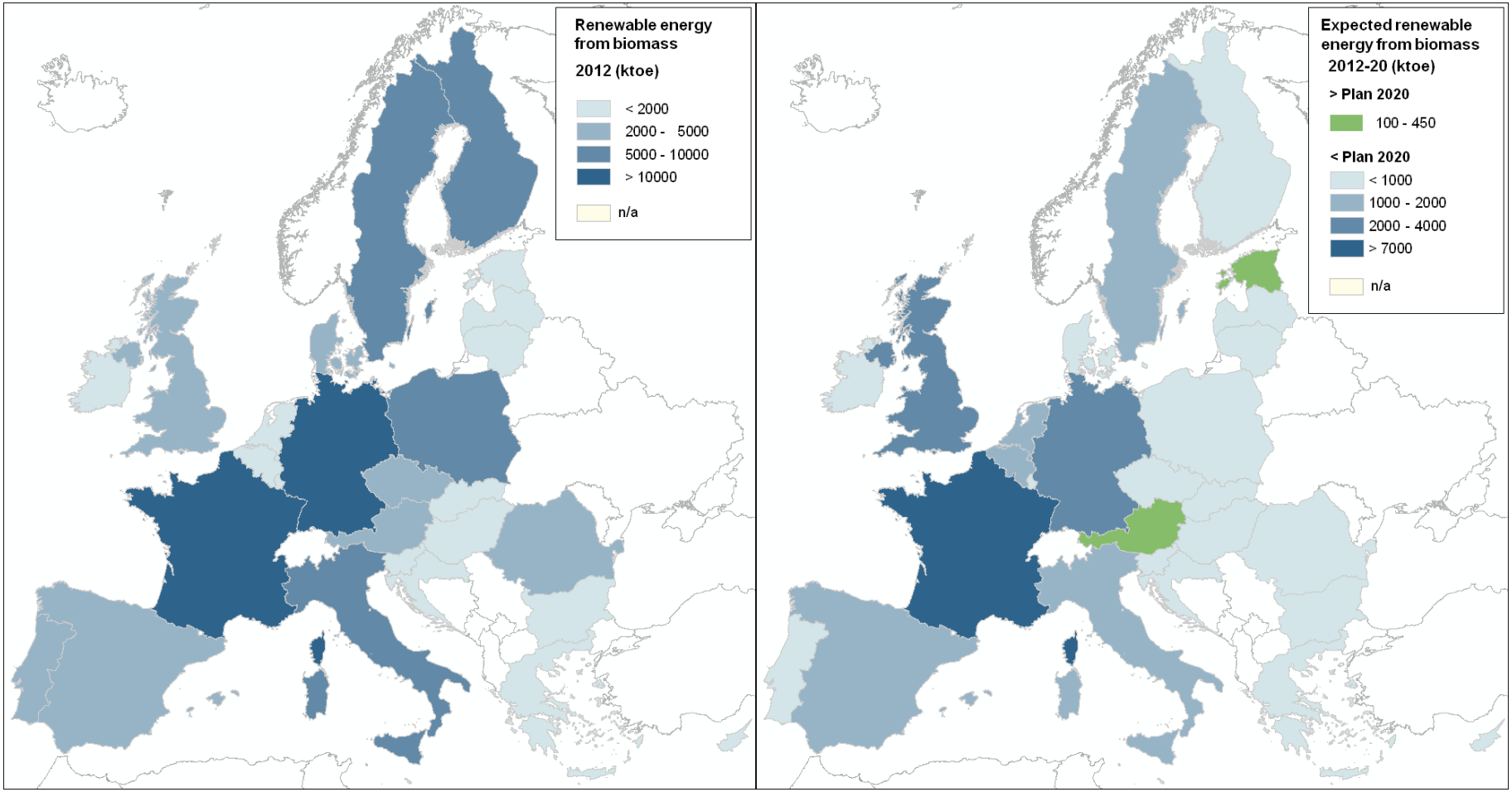

Figure 40. Renewable energy from biomass in each EU MS, 2012 (left) – gap to 2020 (right)

8.1 Biomass electricity

8.1.a. Installed Capacity

The EU almost doubled the installed bioelectricity capacity between 2005 and 2012 reaching 28.7 GW in 2012 from 15.7 GW in the baseline year. Its share in the total renewable electricity installed capacity reached 9.2% in 2012, slightly smaller than 9.3% in the baseline year. The development of bioelectricity capacity in the EU was faster between 2011 and 2012 with a CAGR of 12.9% comparing with periods 2005-2012 (CAGR of 12.3%) and 2010-2011 (CAGR of 1.8%). In 2020 the EU has planned to reach a bioelectricity installed capacity of 43.7 GW keeping the share of 9.1% in the total renewable electricity expected to be installed.

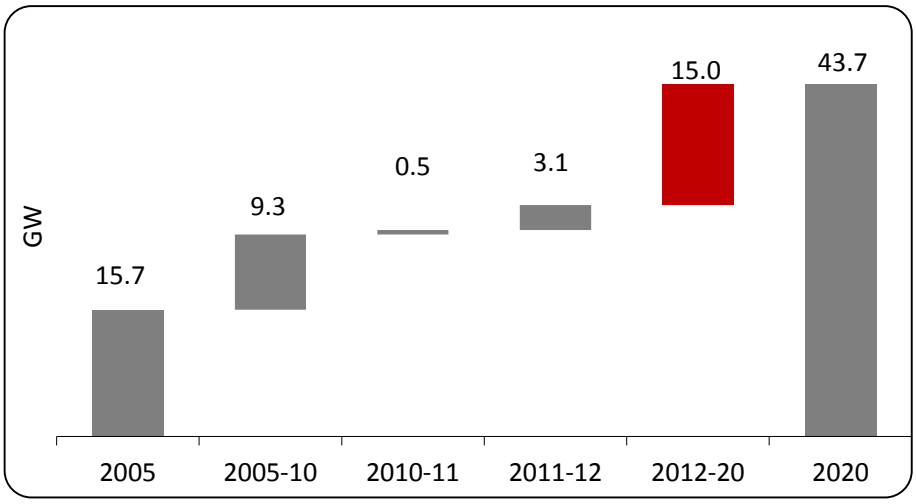

Figure 41. Biomass installed capacity progress in the EU, 2005-2020

11 Member States (BE, CZ, DK, IT, CY, LV, AT, SK, FI, SE and UK) missed their plans in bioelectricity capacity in 2012. From this group only Finland decreased (184 MW less) its bioelectricity capacity between 2005 and 2012 reaching 1956 MW which was 4.1% (-84 MW) below the expected level of its NREAP. Lithuania had the fastest development in biomass capacity increasing the installed figure by a CAGR of 40.1% followed by Czech Republic with a CAGR of 35.4% and Latvia with a CAGR of 30.9%.

In 2012 almost two-thirds of installed bioelectricity capacity was found in five Member States: Germany (6052 MW), Sweden (4055 MW), Italy (3555 MW), United Kingdom (3251 MW) and Austria (2062 MW).

Bioelectricity capacity had in 2012 the highest penetration in total renewable electricity capacity in Hungary with 47% together with Finland with 36%. In this year the penetration of bioelectricity capacity reached 21.3% of total renewable electricity capacity in Denmark and 20.9% in United Kingdom.

In 2020 Germany will still remain the most advanced country in bioelectricity installed capacity with 8825 MW. Together with United Kingdom (4240 MW), Italy (3820 MW), France (3007 MW) and Sweden (2914 MW) it will cover more than half of total installed bioelectricity capacity in the EU.

The highest penetration of bioelectricity in the renewable electricity capacity in 2020 is expected to be found in Denmark with 41.1% followed by Lithuania with 39% and Finland with 34.2%.

3.8.1.b. Contribution to renewable electricity

The amount of bioelectricity in EU reached in 2012 142 TWh (511.4 PJ) increasing by a CAGR of 10.9% between 2005 and 2012, slightly higher than the expected CAGR (10.2%) from the aggregated NREAPs. The share bioelectricity in final renewable electricity in the EU reached 19% and its contribution to final renewable energy reached 7.7% in the same year. The fastest development of bioelectricity took place between 2011 and 2012 with a CAGR of 12.9% comparing with periods 2005-2010 (CAGR of 12.3%) and 2010-2011 (CAGR of 1.8%). In 2020 bioelectricity use is expected to reach 233.2 GWh (839.5 PJ) accounting for 19.3% of the expected final renewable electricity and 8.1% of expected final renewable energy in the EU.

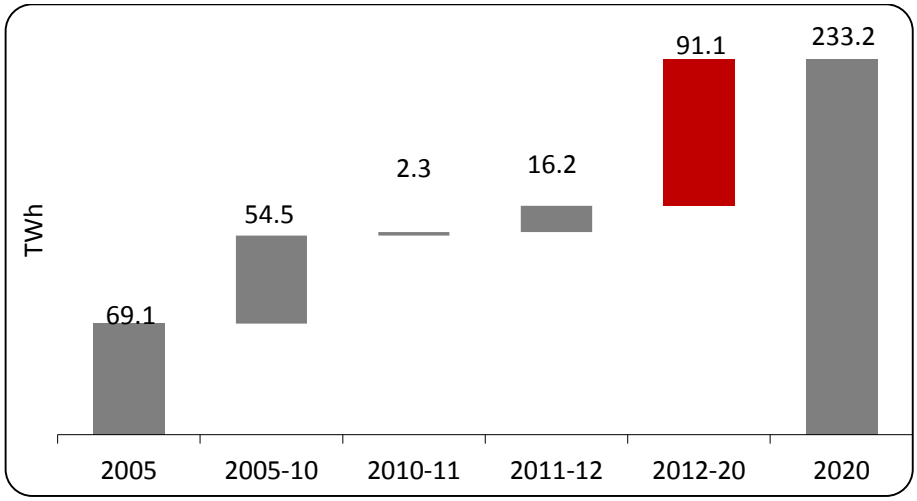

Figure 42. Bioelectricity progress in the EU, 2005-2020

The Member States leading in bioelectricity use in 2012 were Germany with 39.6 TWh (3408.3 PJ), United Kingdom with 15.2 TWh (1307 PJ), Italy with 12.3 TWh (1061.4 PJ), Sweden with 12.2 TWh (1048.3 PJ) and Finland with 10.8 TWh (932.8 PJ).

All member States increased bioelectricity use between 2005 and 2012 although for 13 of them (BG, DK, IE, EL, ES, FR, LT, LU, HU, NL, AT, RO and SI) not enough to reach the expected plans according their NREAPs. On the contrary, Estonia almost tripled the expected NREAP figure (336 GWh) for 2012 already exceeding the 2020 expected level by 655 GWh (+188 %). The highest penetration of biomass in final renewable electricity was indeed found in Estonia (65.7%) followed by Hungary (64.1%), Poland (59.5%), The Netherlands (57.8%) and Belgium (46.2%).

In 2020 the leading Member States in bioelectricity will be Germany with 49.5 TWh (4253.3 PJ), United Kingdom with 26.2 TWh (2249.8 PJ), Italy with 18.8 TWh (1615 PJ), France with 17.2 TWh (1476.7 PJ) and Sweden with 16.8 TWh (1440.8 PJ). The highest shares of bioelectricity in expected final renewable electricity will be found in Hungary (59.4%), Belgium (47.7%), Poland (44.6%), Denmark (43%) and Luxembourg (42.8%).

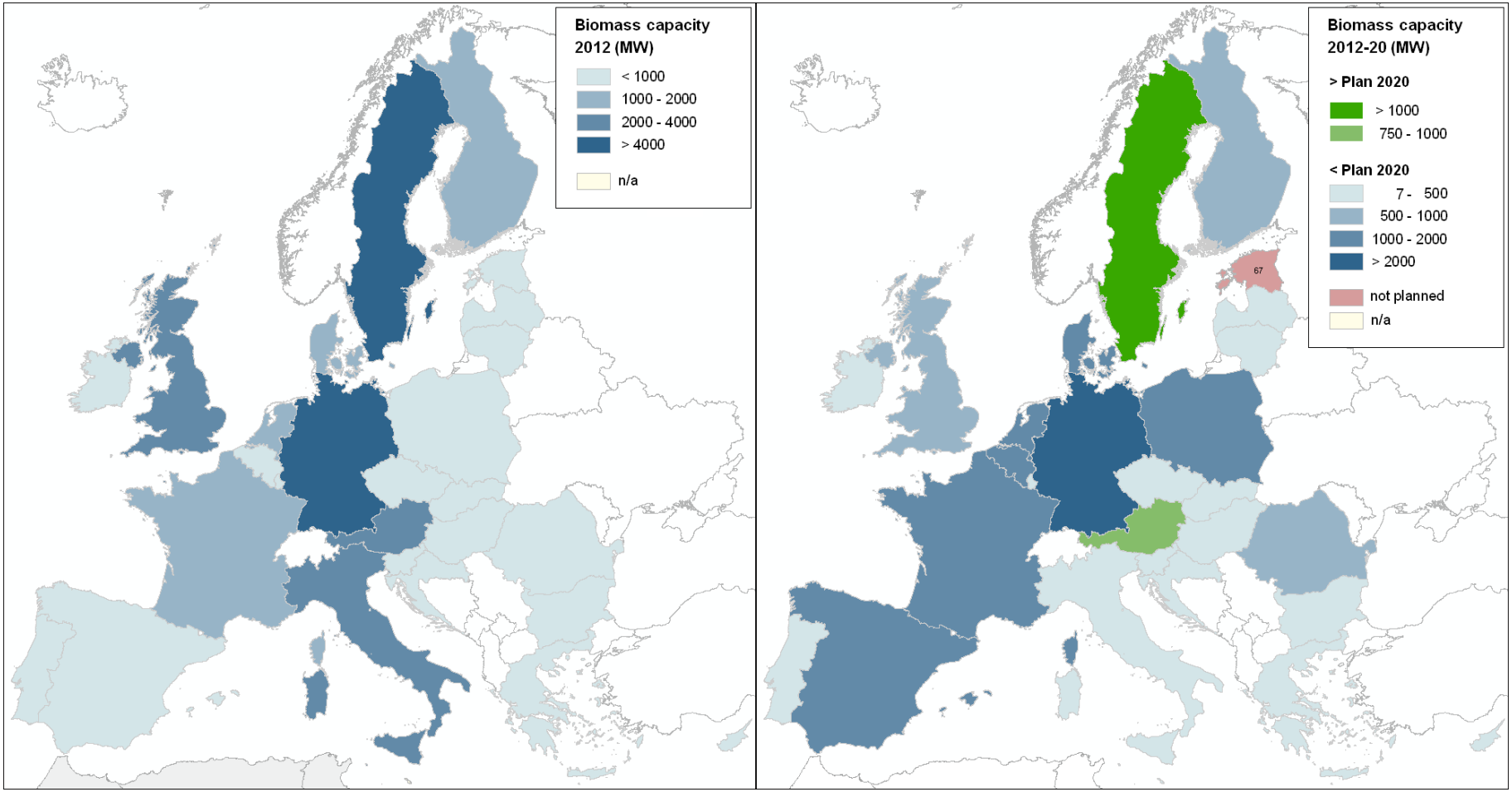

Figure 43. Bioelectricity installed capacity in each EU MS, 2012 (left) – gap to 2020 (right)

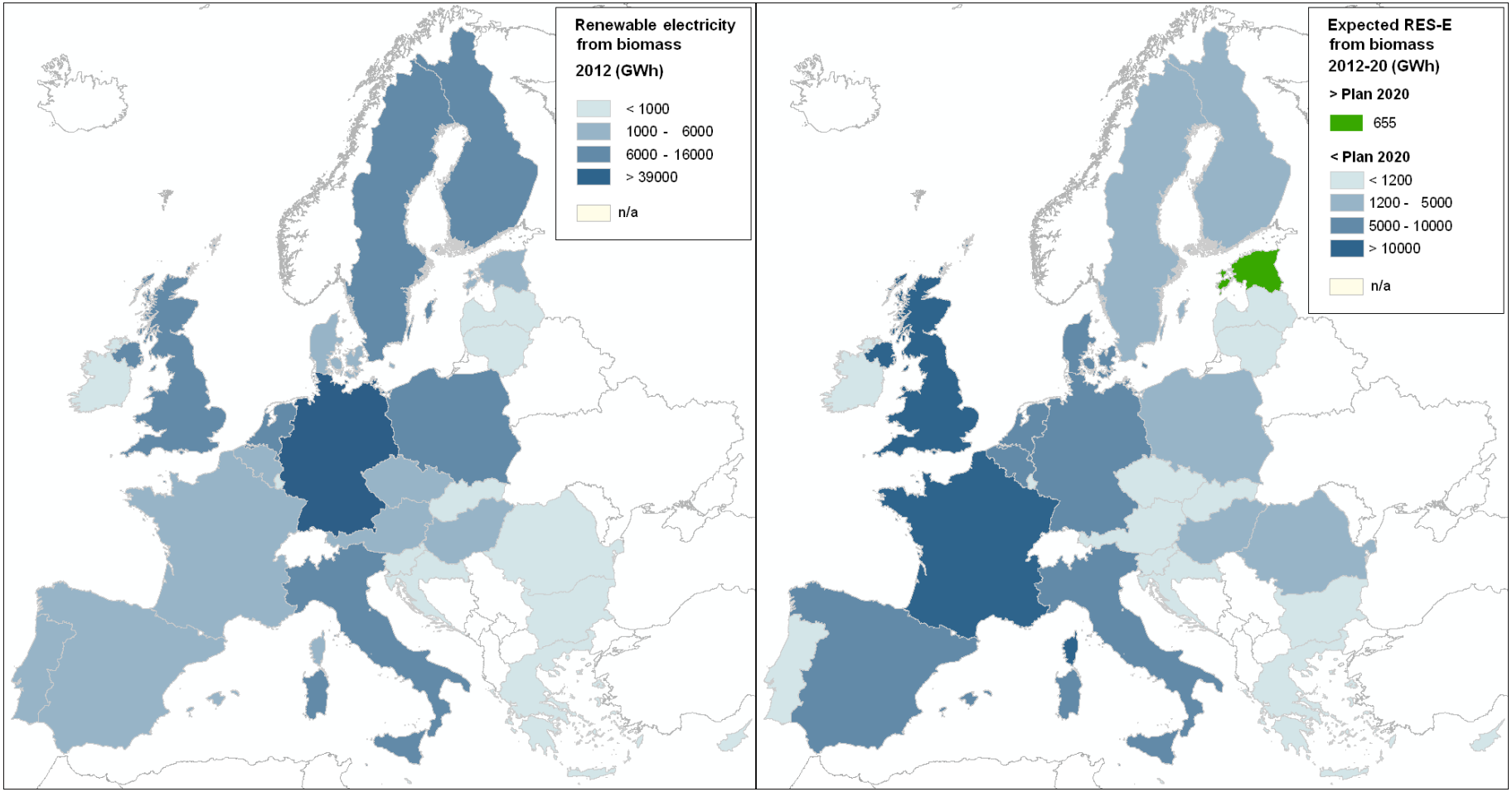

Figure 44. Bioelectricity use in each EU MS, 2012 (left) – gap to 2020 (right)

8.2 Biomass heating/cooling

Biomass heat/cold (bioheat) use in EU increased by a CAGR of 4.6% between 2005 and 2012 reaching 72.7 Mtoe (3045.8 PJ) providing a share of 88.7% of the final renewable heat in the EU. The bioheat contribution to the final renewable energy in the EU reached 45.6% in 2012. Bioheat use developed faster between 2005 and 2010 with a CAGR of 6.9% comparing with periods 2010-2011 (CAGR of -7.4%) and 2011-2012 (CAGR of 5.7%). In 2020 bioheat will still grow with a CAGR of 2.8% reaching 90.4 Mtoe (3785.3 PJ). Its penetration in final renewable heat will decrease to 80.9% and its share in final renewable energy will reach 36.4%.

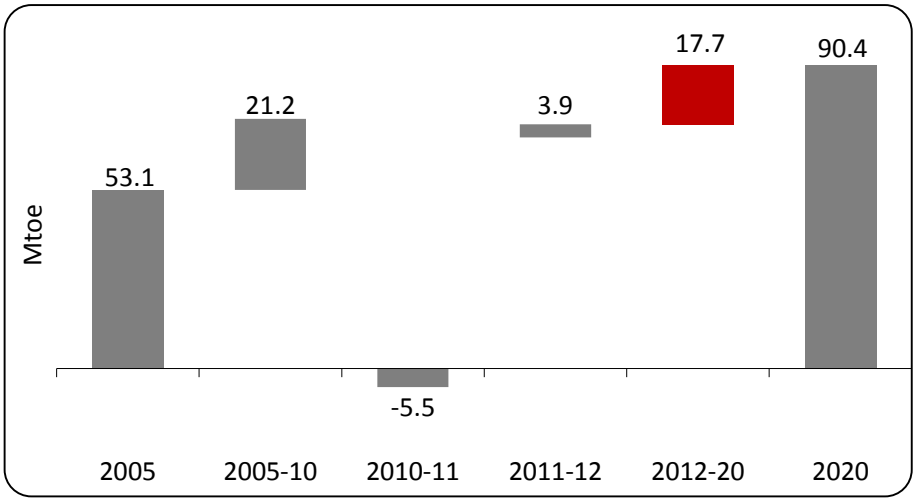

Figure 45. Biomass renewable heating/cooling progress in the EU, 2005-2020

Five Member States (HR, PT, RO, FI and UK) had planned to decrease bioheat between 2005 and 2012, but in fact only Croatia and Portugal did it. Comparing with aggregated NREAPs bioheat developed slower than expected in 7 Member States (CZ, DK, IE, FR, MT, NL and PT). This biomass category experienced the fastest development between 2005 and 2012 in Poland, with a CAGR of 77.9%, in Cyprus with a CAGR of 21.1% and in Belgium with a CAGR of 14.7%.

In 2012, the leading Member States in the EU were France with 10.3 Mtoe (431.6 PJ), Germany with 10 Mtoe (418.6 PJ), Sweden with 8.5 Mtoe (354.7 PJ), Finland with 6.4 Mtoe (266.5 PJ) and Poland with 5 Mtoe (209.3 PJ). Only in Cyprus and Malta the penetration of bioheat in renewable heating/cooling remained below the 20%. In all other member States bioheat accounts for at least 80% of renewable heating and in Estonia and Latvia bioheat is the only source used for renewable heating/cooling.

In 2020, leading Member States in bioheat are expected to be France with 16.5 Mtoe (688.9 PJ), Germany with 11.4 Mtoe (475.4 PJ), Sweden with 9.5 Mtoe (397.4 PJ), Finland with 6.6 Mtoe (276.7 PJ) and Italy with 5.7 Mtoe (237.4 PJ). In 2020, the share of bioheat in final renewable heat is expected to be 100% in Estonia, 99.7% in Latvia, 97.3% in Lithuania, 97.3% in Bulgaria and 96% in Romania. The penetration of this biomass category in renewable heat in Cyprus and Malta is expected to reach respectively 24.4% and 38.4%.

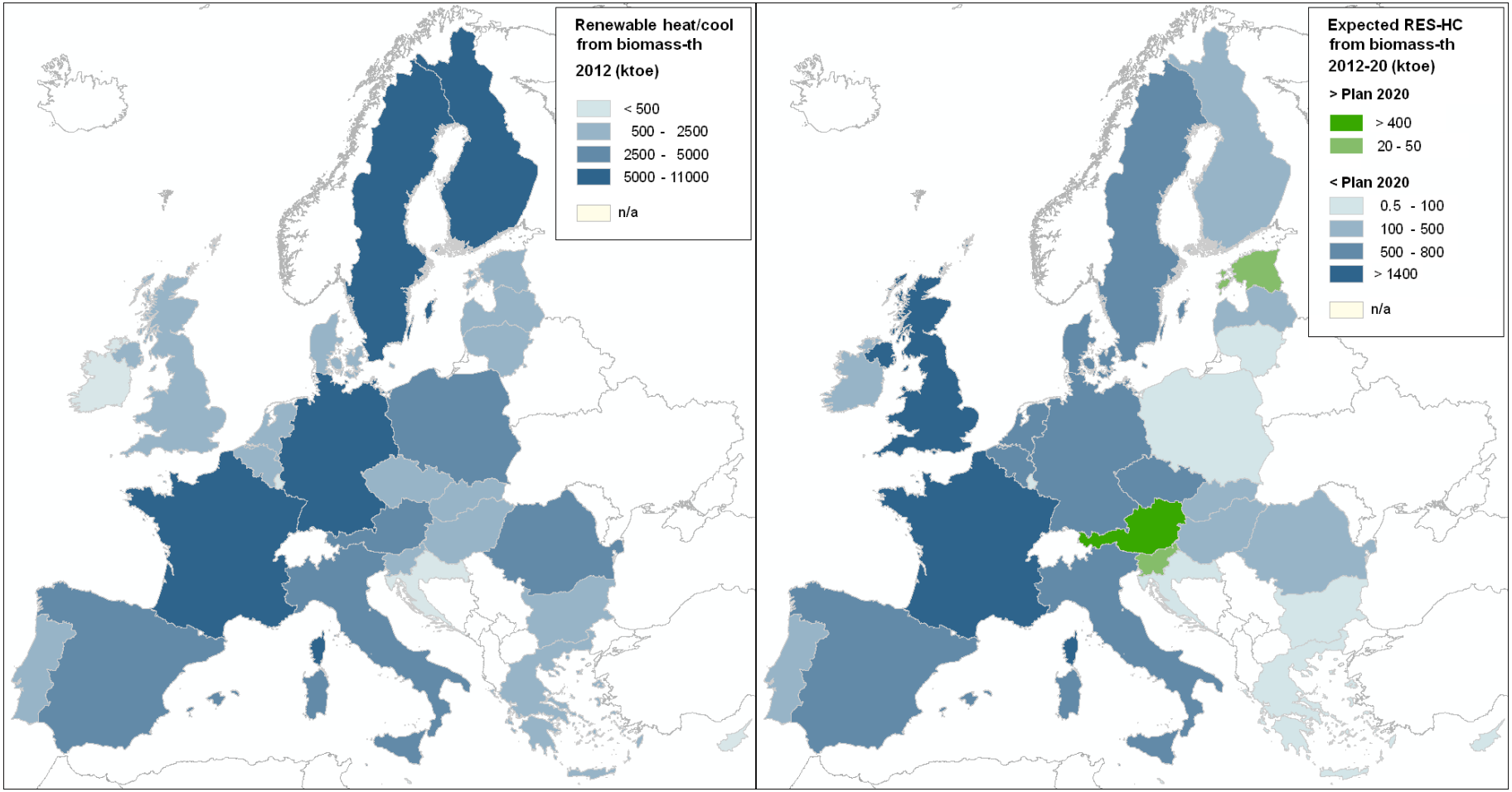

Figure 46. Bioheat use in each EU MS, 2012 (left) – gap to 2020 (right)

8.3 Solid biomass

In 2012 solid biomass used for energy purposes totalled to 78.2 Mtoe (3275 PJ), already 92% (78.2 Mtoe) of biomass for energy purposes (in both electricity and heat/cold sectors) contributing with 49.5% in final renewable energy in the EU. In 2012 solid biomass consumed in electricity sector covered only 10.2% of total solid biomass consumed for energy in the EU, the rest was made by solid biomass consumed for heat/cold purposes. The fastest development of solid biomass took place during period 2011-2012 with a CAGR of 8.6% comparing with period 2005-2010 (CAGR of 7.8%) and 2010-2011 (CAGR of -6.7%).
In 2020 solid biomass consumed for energy purposes in the EU is expected to amount to 94.3 Mtoe (3949 PJ) but its contribution in the expected final use of biomass for energy and final renewable energy will decrease respectively to 85.4% and 31.9%. In 2020 the use of solid biomass in electricity sector is expected to increase its contribution in total solid biomass energy uses reaching 14.2%.

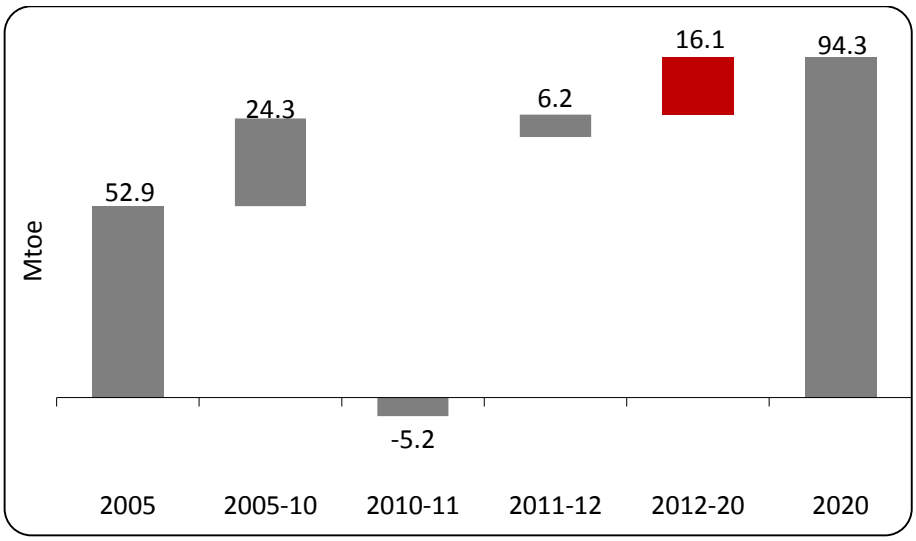

Figure 47[16]**.** Solid biomass capacity progress in the EU, 2005-2020

Leading Member States in the EU in solid biomass use for energy purposes in 2012 were France with 10.5 Mtoe (441.2 PJ), Germany with 9.8 Mtoe (409.5 PJ), Sweden with 9.5 Mtoe (409.2 PJ), Finland with 7.2 Mtoe (303 PJ) and Poland with 5.7 Mtoe (240 PJ). Solid biomass energy uses experienced a very fast growth in five Member States (EE, AT, PL, PT and FI) exceeding not only the expected figures for 2012 but even the plan for 2020. On the contrary, seven Member States (CZ, DK, IE, ES, FR, CY and NL') missed their NREAPs plans in 2012.

In Bulgaria biomass consumed for energy purposes in 2012 was almost totally solid biomass. Malta had the lowest share of solid biomass in final use of biomass for energy with 49.2%. All other Member States count on solid biomass for more than 75% of their biomass use in energy sector. Contribution of solid biomass in final renewable energy reached the lowest level in Malta with 5.8% and the highest in Estonia with 94%. In 2012 Malta consumed solid biomass only in heating/cooling sector even that the figure is very marginal. Only the

[16] Czech Republic in its 2013 progress report didn't divide the biomass into subcategories for year 2011.

Netherlands and United Kingdom had in 2012 almost the same share of solid biomass consumed in electricity and in heating/cooling sectors where still the heating/cooling sector had the highest. In all other Member States biomass consumed for heat/cold had the dominating share.

In 2020 the contribution of solid biomass in final biomass use for energy will decrease slightly in the majority of Member States. Only in the Netherlands, Portugal and Finland the share of solid biomass in final use of biomass is expected to decrease significantly respectively from 84.2% to 56.9%, from 99.1% to 61.4% and from 99.2% to 59.8%. The use of solid biomass for electricity purposes is expected to increase slightly up to 2020 except PT, SK and UK where the increase will be at the side of heat/cold.

Leading Member States in solid biomass for energy in 2020 are expected to remain France with 17.1 Mtoe (714.2 PJ), Germany with 11.2 Mtoe (463.3 PJ), Sweden with 10.8 Mtoe (454.1 PJ), Italy with 5.9 Mtoe (165.3 PJ) and Poland with 5.5 Mtoe (230.8 PJ).

8.3.1 Solid biomass electricity

8.3.1.a. Installed capacity

Installed capacity of solid biomass electricity (hereafter solid biomass-el) reached 18.5 GW[17] in 2012 increasing with a CAGR of 8.3% between 2005 and 2012. Penetration of solid biomass-el in total biomass installed capacity in the EU in 2012 was 64.5% whereas accounting for 5.9% in total renewable electricity capacity in this year. The fastest development of solid biomass-el capacity took place between 2005 and 2010 with a CAGR of 12.6% comparing with periods 2010-2011 (CAGR of -9.3%) and 2011-2012 (CAGR of 6.6%). In 2020 solid biomass-el capacity is expected to reach 27.9 GW, growing with a CAGR of 5.2% and slightly decreasing its shares in total biomass and renewable electricity capacity reaching respectively 63.7% and 5.8%.

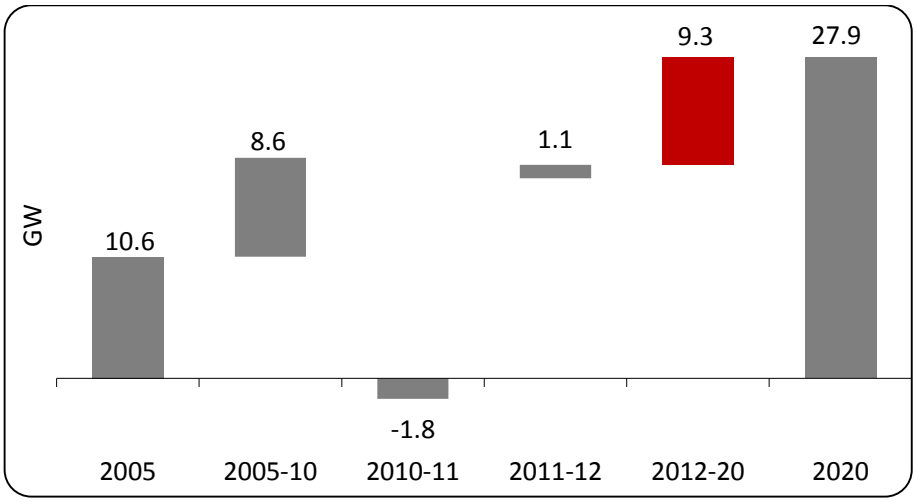

Figure 48. Solid biomass installed capacity progress in the EU, 2005-2020

[17] In its 2013 progress report Czech Republic reported on renewable electricity originated from solid biomass but no installed capacity for this biomass subcategory is reported for 2011 and 2012.

Estonia had no plans to introduce solid biomass capacity in electricity sector but since in 2009 it had in place 35 MW which increased to 63 MW in 2010 remaining unchanged till 2012. Solid biomass-el capacity had the highest relative increase in Lithuania with a CAGR of 52.3% even that slightly lower than the planned 53.4%. Only Germany decreased the solid biomass-el capacity between 2005 and 2012 being 393 MW below the baseline level. Leading member States in solid biomass-el capacity in 2012 were Sweden with 3542 MW, Germany with 2034 MW, United Kingdom with 2016 MW, Finland with 1956 MW and Austria with 1672 MW.

In 2020, the leading countries are expected to be Germany with 4792 MW, followed by UK with 3140 MW, Sweden with 2872 MW, Denmark with 2404 MW and France with 2382 MW. The installed capacity of solid biomass-el plants in these five countries will increase to 15590 MW in 2020, representing 56.1% of the overall capacity in the EU.

8.3.1.b. Contribution to renewable electricity

Solid biomass contribution in electricity sector (hereafter solid biomass-el) increased with a CAGR of 7.7% between 2005 and 2012, from 55.1 TWh (198.2 PJ) to 92.4 TWh (332.6 PJ). In 2012 the share of solid biomass-el in final use of biomass for energy purposes in the EU amounted to 9.4% while the penetration of solid biomass-el in renewable electricity and final renewable energy was respectively 12.4% and 5% in 2012. The fastest development of the solid biomass use in electricity sector took place between 2005 and 2010 with a CAGR of 11% comparing with period 2010-2011 (CAGR of -8.5%) and 2011-2012 (CAGR of 8.8%). In 2020 solid biomass-el is expected to reach 156.2 TWh (562.3 PJ) increasing with a CAGR of 6.8% from year 2012. Its share in total solid biomass use for energy purposes is expected to increase up to 14.2% while its contribution to renewable electricity and final renewable energy will reach 12.9% and 5.5% respectively.

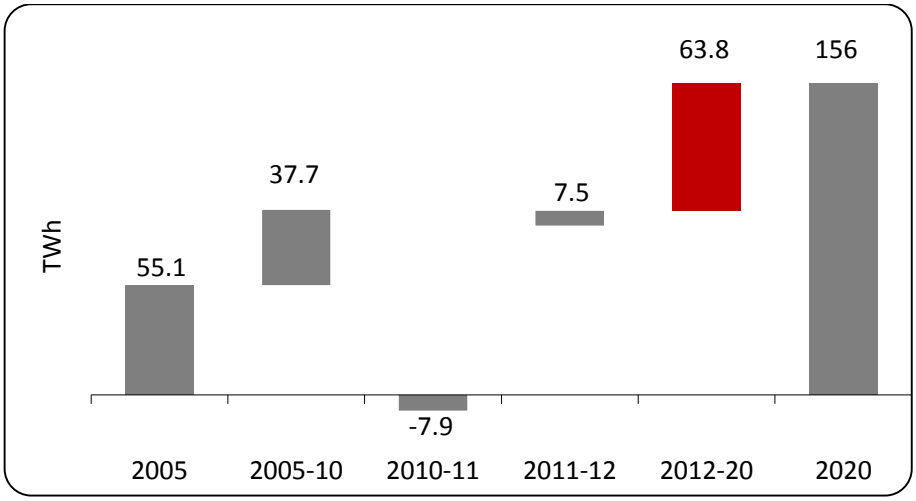

Figure 49. Solid biomass renewable electricity progress in the EU, 2005-2020

14 Member States (BG, DK, DE, EL, ES, FR, IT, LU, HU, MT, NL, AT, RO and SI) reported lower use of solid biomass-el for energy in comparison with plans or no use at all. On the contrary in 2012 Estonia reported an unplanned solid biomass-el use of 985 GWh (3.5 PJ). Portugal developed faster than planned the use of solid biomass-el already doubling in 2012 the 2020 plan of 2986 GWh (10.7 PJ). Finland had planned to reduce the amount of solid

biomass-el but in 2012 it reported a figure higher than the 2012 plan but even higher than the 2020 plan.

Leading Member States in the use of solid biomass-el 2012 were Sweden with 12.2 TWh (43.8 PJ), Germany with 12.1 TWh (43.5 PJ), Finland with 10.7 TWh (38.5 PJ), Poland with 9.5 TWh (34.3 PJ) and United Kingdom with 9.3 TWh (33.6 PJ), accounting altogether for 58.2% of EU uses. Almost two-third of renewable electricity in Estonia in 2012 was indeed coming from the unplanned use of solid biomass electricity while in Hungary this contribution accounted for more than half of renewable electricity consumed in this Member State. The Netherlands experienced the highest penetration of solid biomass-el in renewable electricity with a 22.8% share in 2012 having also the highest share in biomass consumed for energy purposes.

In 2020, leading countries in solid biomass-el are expected to be Germany with 24.6 TWh (88.4 PJ), United Kingdom with 20.6 TWh (74.1 PJ), Sweden with 16.6 TWh (59.9 PJ), France with 13.5 TWh (48.5 PJ) and The Netherlands with 11.97 TWh (43.1 PJ) covering 55.8% of expected solid biomass-el in the EU. Hungary is expected to show in 2020 the highest penetration of solid biomass-el (48%) in its renewable electricity while the highest share in final renewable energy and final biomass use for energy are expected to be respectively in Belgium (15.3%) and Malta (44.9%).

8.3.2 Solid biomass heating/cooling

Solid biomass consumed in heating/cooling sector reached 70.3 Mtoe (2942.8 PJ) in 2012 increasing with a CAGR of 5.5% from the baseline figure of 48.2 Mtoe (2017.3 PJ). In 2012 almost 86% of renewable heating/cooling in the EU was coming from the use of solid biomass-th while the contribution to the final renewable energy amounted to 44.4%. The fastest development of solid biomass-th took place between 2011 and 2012 with a CAGR of 8.6% comparing with periods 2005-2010 (CAGR of 7.5%) and 2010-2011 (CAGR of -6.5%). Up to 2020 solid biomass use for heating/cooling is expected to be developed with a CAGR of 1.8% in order to reach the plan of 80.9 Mtoe (3386.6 PJ). In relative terms the solid biomass use for heating/cooling contribution in renewable heating/cooling and final renewable energy is expected to decrease respectively to 72.4% and 33%.

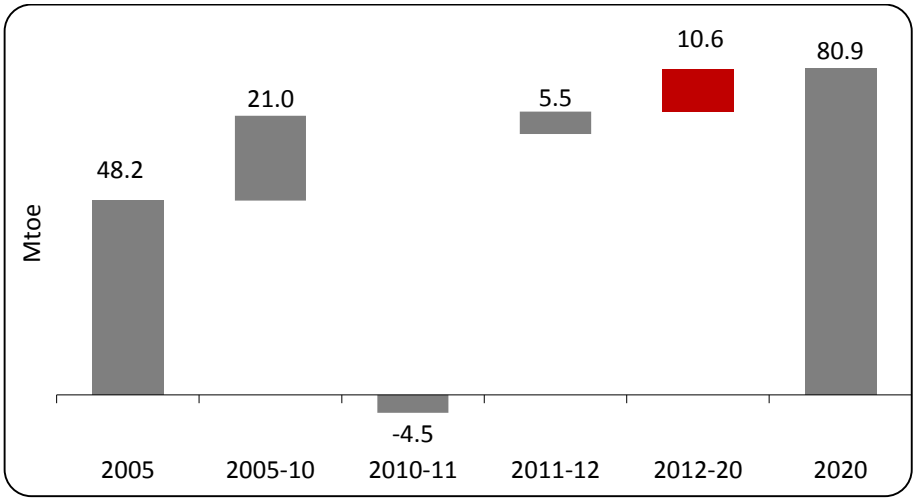

Figure 50. Solid biomass renewable heating/cooling progress in the EU, 2005-2020

Only five Member States (CZ, DK, IE, FR and CY) in 2012 developed this technology slower than expected while Estonia, Austria, Poland, Portugal, Slovenia and Slovakia exceed already in 2012 their plans for 2020. Although not planned since 2009 Malta reported on solid biomass use for heating/cooling with an amount of 0.5 ktoe that reached 0.65 ktoe in 2012. Finland had planned to decrease by 44% (-2.4 Mtoe) the use of solid biomass for heating/cooling between 2005 and 2012 while in fact an increase by 15.8% (+866 ktoe) took place during this time span.

Nearly 55% of solid biomass for heating/cooling was consumed in France (10.2 Mtoe), Germany (8.7 Mtoe), Sweden (8.4 Mtoe), Finland (6.3 Mtoe) and Poland (4.9 Mtoe). In 2012 Estonia (99.8%) and Romania (99.2%) had the highest penetration of solid biomass for heating/cooling in final renewable heating/cooling while Malta (9.7%) and Cyprus (14.3%) had the lowest shares. Lithuania had the highest penetration (84.5%) of solid biomass for heating/cooling in final renewable energy followed by Estonia with 83.2%. In Bulgaria and Romania the total biomass used for energy purposes in year 2012 was almost totally made of solid biomass for heating/cooling purposes.

In 2020, leading countries in solid biomass for heating/cooling is expected to be France with 15.9 Mtoe (665.7 PJ), Sweden with 9.4 Mtoe (394.2 PJ), Germany with 8.9 Mtoe (374.8 PJ), Italy with 5.2 Mtoe (220.0 PJ), and Poland with 4.6 Mtoe (194.1 PJ). In 2020, the share of solid biomass for heating/cooling in final renewable heat is expected to be 100% in Estonia, 96.2% in Latvia, 95.5% in Bulgaria, 95.2% in Romania, 92.6% in Lithuania. Estonia is expected to have also the highest penetration in final renewable energy in 2020 with 70.5% together with Latvia (70%) and Lithuania (66.1%).

8.4 Biogas

Biogas use for energy purposes (electricity and heat/cold) in the EU reached 6228.4 ktoe (260.8 PJ) in 2012 increasing with a CAGR of 20.5% between 2005 and 2012. The share of biogas in final use of biomass for energy reached 7.3% in 2012 while the contribution in final renewable energy was 3.9%. In 2012 biogas use for electricity covered nearly two-third of total biogas consumed for both electricity and heating/cooling.

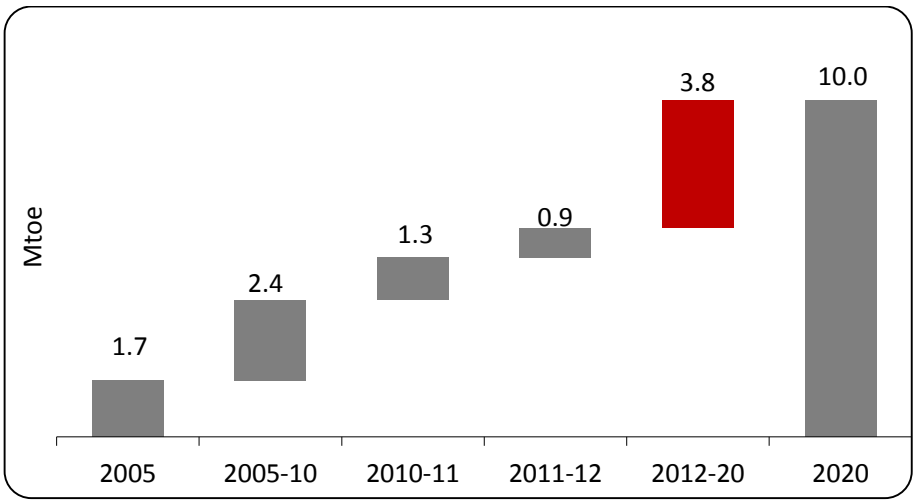

Figure 51. Biogas progress in the EU, 2005-2020

The fastest development of biogas for energy took place between 2010 and 2011 with a CAGR of 31% comparing with periods 2005-2010 (CAGR of 19.4%) and 2011-2012 (CAGR of 16.3%). In 2020 biogas is expected to grow with a CAGR of 6.1% in order to reach the plan of 10 Mtoe (419.6 PJ). The contribution of biogas in both final energy-related biomass and final renewable energy will increase respectively to 9.1% and 4.1%. The difference between the shares of biogas electricity and biogas for heating/cooling up to 2020 will become smaller due to the fastest increase of biogas use in for heating purposes.

Although not planned, Estonia reported 1.6 ktoe in 2009 of biogas use for energy purposes, amount which increased to 2.4 ktoe in 2012. Austria and Sweden already exceeded in 2012 their plans for 2020 respectively by 35 ktoe (1.5 PJ) and 29.2 ktoe (1.2 PJ). On the contrary, biogas use in energy developed slower than planned in 13 Member States (BG, CZ, DK, IE, LT, LU, MT, NL, PL, PT, RO, SK and UK). In 2012 Bulgaria and Portugal consumed biogas only for electricity purposes. Biogas had the highest share in final use of biomass for energy purposes in Malta (50.8%) and Cyprus (42.4%) while the lowest shares were found in Romania (0.3%), Sweden (0.5%) and Finland (0.7%).

82% of biogas consumed in the EU energy sector was coming from Germany (3427.5 ktoe), United Kingdom (583.2 ktoe), Italy (580.3 ktoe), France (261.4 ktoe) and Czech Republic (234.2 ktoe).

In 2020 leading Member States are expected to be Germany (3707.7 ktoe), France (873.3 ktoe), Poland (798.5 ktoe), Italy (783.7) and United Kingdom (781 ktoe) with a contribution of 69.3% in final use of biogas in the EU. Except six Member States (BE, DE, IE, AT, SE and UK), all other Member States are expected to increase the share of biogas in final biomass use for energy purposes. The highest shares of biogas in final use of biomass for energy are still expected to be found in Malta (55.1%) and Cyprus (43.1%).

8.4.1 Biogas electricity

8.4.1.a. Installed Capacity

Biogas installed capacity in the EU reached 8339 MW in 2012 increasing with a CAGR of 17.7% between 2005 and 2012. Almost one-third of biomass electricity capacity in 2012 was made by biogas, which corresponds to a penetration of 2.7% in final renewable electricity installed capacity. Biogas installed capacity developed faster between 2010 and 2011 with a CAGR of 55.7% comparing with periods 2005-2010 (CAGR of 11.3%) and 2011-2012 (CAGR of 17.5%). In 2020 the biogas capacity is expected to amount to 11232 MW although its relative contribution to bioelectricity and renewable electricity capacity will decrease respectively to 25.7% and 2.4%.

Half of member States (BE, BG, IE, EL, LT, LU, MT, NL, PT, RO, SI, SK, SE and UK) were below the planned figures reported in their NREAPs and, Bulgaria and Malta didn't report on biogas electricity capacity for 2012, although planned.

United Kingdom has planned to decrease since 2010 its biogas electricity capacity while according to its NREAP Estonia had no plans to develop biogas electricity. Nevertheless,

Estonia already installed 2 MW of this technology which reached 4 MW in 2010 remaining in this level even in 2012.

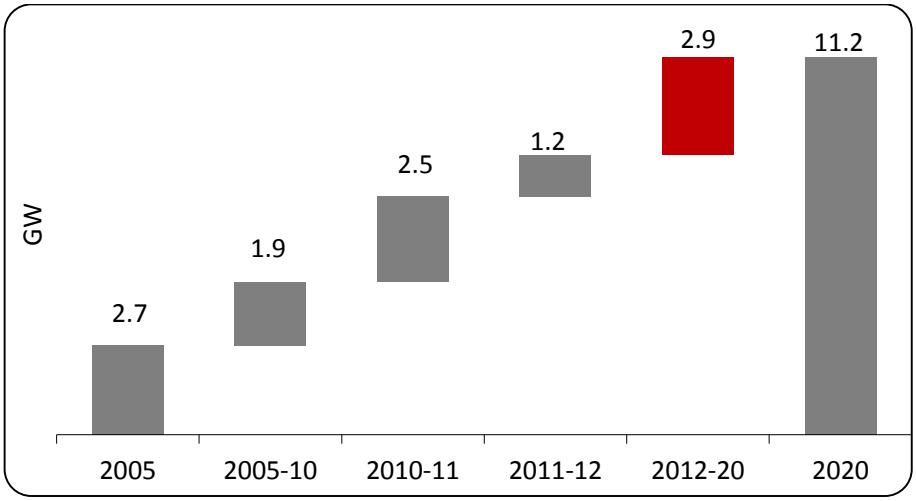

Figure 52. Biogas installed capacity progress in the EU, 2005-2020

Italy more than doubled its biogas electricity capacity in 2012 compared with its NREAP plan of 602 MW for this year exceeding by 74 MW (+6.2%) the 2020 planned value of 1200 MW. Austria reached in 2012 almost four time-folds the planned biogas capacity of 98 MW for this year also exceeding the 2020 plan by +275 MW (+270%). Germany, Italy and United Kingdom with respectively 3764 MW, 1274 MW and 1235 MW covered almost three-fourths of total biogas power capacity in EU.

In 2020, according to NREAPs the leading Member States in biogas power installed capacity are expected to be Germany with 3796 MW, followed by Italy with 1200 MW, UK with 1100 MW, Poland with 980 MW and the Netherlands with 639 MW. The installed capacity of biogas plants in these five countries is expected to reach 7715 MW in 2020, representing 68.7% of the biogas power plant capacity in the EU.

8.4.1.b. Contribution to renewable electricity

Contribution of biogas to renewable electricity (biogas-el) reached 46.4 TWh (167.2 PJ) in 2012 increasing with a CAGR of 20.6% (+34 TWh) from the baseline level. The share of biogas technology in renewable electricity in the EU reached 6.2% in 2012 from 2.5% in the baseline year. The fastest development of biogas-el took place between 2010 and 2011 with a CAGR of 54.9% comparing with periods 2005-2010 (CAGR of 14.4%) and 2011-2012 (CAGR of 22.6%). In 2012 biogas-el covered almost one-third of biomass-el contribution in electricity sector and in 2020 it is expected to reach 64 TWh (230.1 PJ) increasing by only 4.1% annually. Despite of this increase the share of biogas-el in renewable electricity in 2020 is expected to decrease to 5.3% as well as it contribution in biomass-el which is expected to reach 27.4%. Nevertheless, biogas-el is expected to slightly increase its share in final biomass used for energy purposes from 4.7% in 2012 to 5% in 2020.

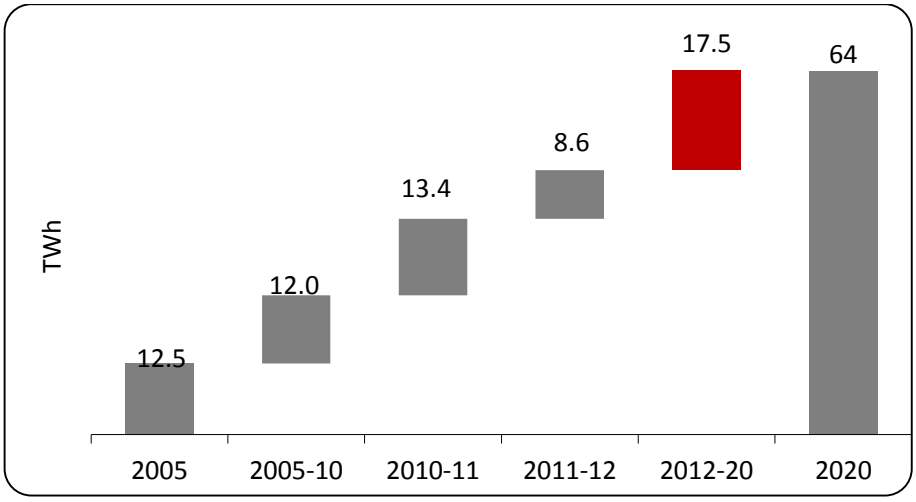

Figure 53. Biogas renewable electricity progress in the EU, 2005-2020

The development of biogas-el in 2012 was faster than planned in half of Member States. Finland had the highest positive deviation from NREAPs value in relative terms (+250%) whereas Germany had the highest positive deviation in absolute terms (+11.3 TWh) in 2012. United Kingdom had the highest negative deviation in absolute terms (-746 GWh) whereas Bulgaria had the highest negative deviation in relative terms (-97%) from the expected NREAPs respective figures for 2012. Biogas-el in Germany increased so fast that it exceeded in 2012 the expected 2020 plan of 23.4 TWh by 16.2% (+3.8 TWh). Austria also exceeded in 2012 the expected 2020 figure of biogas-el by 58 ktoe (+9.9%). Leading Member States in 2012 were Germany with 27.2 TWh (98.1 PJ), United Kingdom with 5.9 TWh (21.1 PJ), Italy with 4.6 TWh (16.6 PJ), Czech Republic with 1.5 TWh (5.3 PJ) and France with 1.3 TWh (4.6 PJ) with an overall contribution of almost 90% of biogas-el consumed in the EU the same year.

In 2012 the share of biogas-el in final use of biogas for energy was 86.6% in United Kingdom, 80.5% in Croatia, 68.5% in Italy and 68.3% in Germany. Greece and Malta used only biogas as biomass source to contribute in the electricity sector even if a contribution of solid biomass was also planned. Germany, Cyprus and Malta had the highest penetration of this biomass subcategory in their renewable electricity respectively with 19.96%, 19.52% and 18.22%. United Kingdom had the highest penetration of this biogas category in final biomass (21.9%) consumed for energy purposes and in its final renewable energy (9.1%).

In 2020, leading countries in biogas-el are expected to be Germany with 23.4 TWh (84.4 PJ), Italy with 6.0 TWh (21.7 PJ), United Kingdom with 5.6 TWh (20 PJ), the Netherlands with 4.7 TWh (16.8 PJ) and Poland with 4 TWh (14.5 PJ). The biogas-el in these five countries will deliver 43.7 TWh (157.4 PJ) in 2020, representing 68.3% of the biogas electricity in the EU. In 2020, the highest shares of biogas power in renewable electricity is expected to be reached in Czech Republic with 24%, Luxembourg with 18.4%, Malta with 18.2%, Lithuania with 14.0% and Poland with 12.6%. Cyprus will continue to consume only biogas as biomass contribution in its renewable electricity in 2020 whereas for Greece this penetration is expected to decrease up to 71% due to the contribution of solid biomass. In 2020 Malta is expected to have the highest penetration (44.6%) of biogas-el in final biomass use for energy purposes in the EU followed by Cyprus (29%) and Germany (12.9%).

8.4.2 Biogas heating/cooling

Biogas consumed for heating and cooling (biogas-th) in the EU accounted for 3.1% of final biomass consumed for heating/cooling sector in the same year reaching 2.2 Mtoe (93.5 PJ) in 2012 increasing with a CAGR of 20.4% between 2005 and 2012. In 2012, its contribution to final biomass consumed for energy purposes was only 2.6% while the penetration in renewable heat and final renewable energy in the EU in the same year was respectively 2.7% and 1.4%. The fastest development of biogas-th took place between 2005 and 2010 with a CAGR of 26.6% compare with periods 2010-2011 (CAGR of 5.5%) and 2011-2012 (CAGR of 6.5%). In 2020 biogas-th is expected to develop with a CAGR of 9.2% in order to reach the planned figure of 4.5 Mtoe (189.5 PJ). Up to 2020 the relative contribution of biogas-th in final biomass use for heat/cold and total biomass will increase respectively to 5% and 4.1%. The same trend of relative shares in renewable heat/cold and final renewable energy is expected to be found in 2020 for the same energy source respectively 4% and 1.8%.

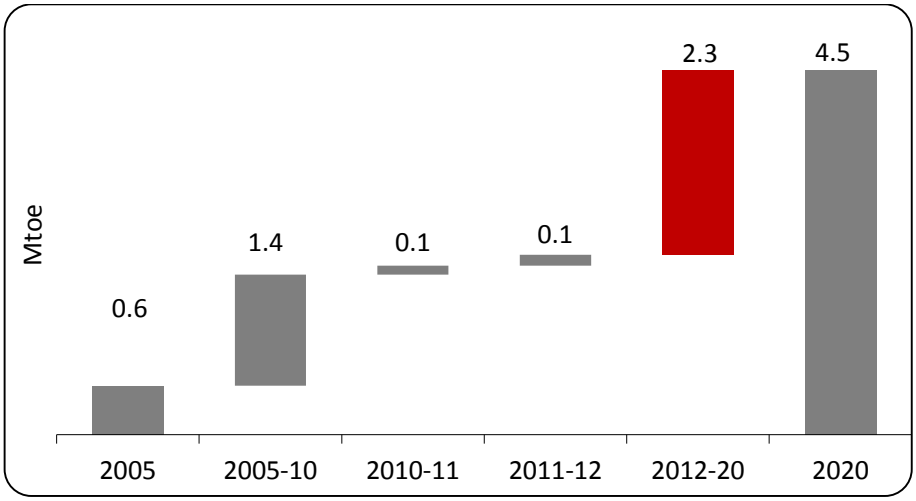

Figure 54. Biogas renewable heating/cooling progress in the EU, 2005-2020

In 11 Member States (BG, CZ, DK, IE, LV, LT, HU, MT, NL, PL and PT) biogas-th did not reach in 2012 its expected contribution. Although they reported since in 2010 a contribution of biogas-th respectively of 1 ktoe and 32 ktoe, Bulgaria and Portugal did not report any biogas-th for 2011-12.

Even that not planned in its NREAP, Estonia reported since in 2010 on the contribution of biogas in its final renewable heat even that this contribution was very marginal. The same was found for Greece and Slovenia which did not plan any biogas-th in their final renewable heat, reaching respectively in 2012 15.2 ktoe (0.64 PJ) and 11.7 ktoe (0.49 PJ). Belgium, Austria and Sweden developed biogas-th faster than planned already exceeding in 2012 the contribution expected in 2020. The penetration biogas-th in the final biomass used for energy and heating/cooling purposes has reached the highest value in Malta respectively with 31% and 38.7%. Cyprus followed with the respective contributions of 21.3% and 27%. The Netherlands had in 2012 the highest share of biogas-th in final renewable heat and final renewable energy respectively with 13.7% and 5.5%.

In 2012, Germany was the leading Member State in biogas-th with 1085 ktoe (45.4 PJ) followed by Italy with 183 ktoe (7.7 PJ), France with 151 ktoe (6.3 PJ), the Netherlands with 129 ktoe (5.4 PJ) and Czech Republic with 108 ktoe (4.5 PJ).

In 2020, leading countries in biogas-th are expected to be Germany with 1692 ktoe (70.8 PJ)), France with 555 ktoe (23.2 PJ), Poland with 453 ktoe (12.6 PJ), United Kingdom with 302 ktoe (12.6 PJ), and the Netherlands with 288 ktoe (12.1 PJ). In these five countries biogas-th will account for 3290 ktoe (137.7 PJ) in 2020, representing 73.5% of the biogas-th in the EU in that year. Malta is expected to have in 2020 only the contribution of this biomass subcategory in heating/cooling sector with a share of 10.4% in final biomass use for energy purposes. The penetration of biogas-th in final renewable heat in 2020 is expected to have the highest value in Malta (38.4%), the Netherlands (13.2%) and Luxembourg (12.4%).

8.5 Bioliquids

The development of bioliquids between 2005 and 2012 followed a negative trend with a negative CAGR of 12.6% (-793.5 ktoe) reaching in 2012 only 505[18] ktoe (21.1 PJ), almost 10 times less than the expected figure in the same year. Bioliquids had a very marginal contribution in final biomass use for energy purposes and final renewable energy in 2012 respectively 0.6% and 0.3%. In 2012 about half of bioliquids (55%) are used for electricity purposes and the rest for heating/cooling. The fastest decrease of bioliquids use took place between 2010 and 2011 with a negative CAGR of 81.3%. In 2020 the absolute contribution of bioliquids is expected to increase with a CAGR of 36.5% (13 times-fold the planned CAGR according to NREAPs) to reach 6094 ktoe (255.2 PJ). The penetration of bioliquids in final use of biomass for energy is expected to reach 5.5%, almost 10 times its share in 2012. In the same year bioliquids contribution to final renewable energy is expected to reach 2.5%, 8 times its share in 2012. In 2020 the bioliquids in heating/cooling sector is expected to reach 82% of total bioliquids expected to be consumed for energy in the same year.

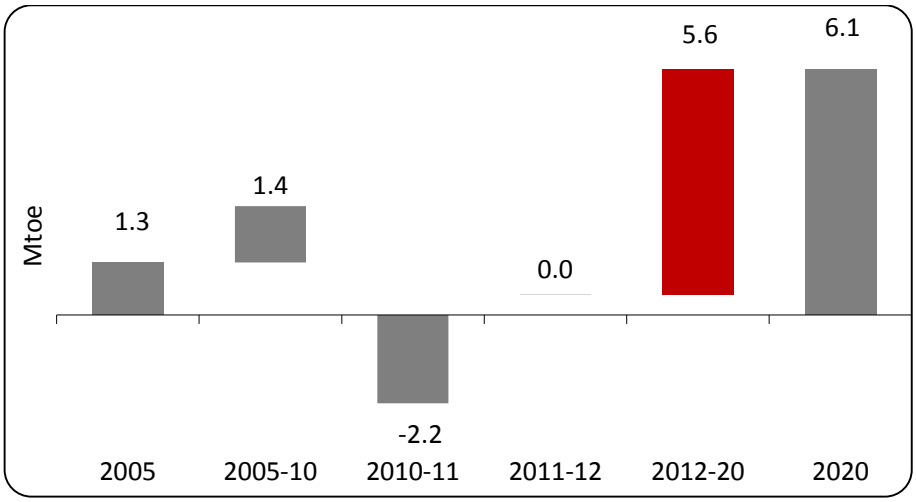

Figure 55. Bioliquids progress in the EU, 2005-2020

[18] The Netherlands reported an installed capacity for bioliquids for period 2009-12 but no contribution in renewable electricity from this biomass subcategory is reported for the same period.

Only 6 Member States (DK, DE, IT, CY, LV and FI) reported on the use of bioliquids for energy purposes (both electricity and heat/cold) while according the NREAPs this number was expected to be more than double.

Cyprus and Latvia had no plans to introduce bioliquids in electricity and heating/cooling sectors. Nevertheless in period 2011-12 both these two Member States reported on the use of this biomass subcategory for energy purposes. Italy had the highest absolute contribution in bioliquids consumed for energy purposes in 2012 with 277 ktoe (11.6 PJ) followed by Germany with 191.5 ktoe (8 PJ). Contributions of Denmark, Finland and Latvia reached in the same year respectively 22 ktoe (0.9 PJ), 12 ktoe (0.5 PJ) and 2.4 ktoe (0.1 PJ). Cyprus consumed bioliquids only for electricity purposes whereas in Italy 92.4% of total bioliquids are consumed in this sector.

Bioliquids was consumed totally for heat/cold in Finland whereas in Latvia and Germany this figure reached respectively 97.1% and 88.8%. The penetration of bioliquids in final biomass use and final renewable energy had the highest shares in Italy respectively with 5% and 1.7% while in Germany this figures reached 1.4% and 0.7%.

In 2020 eleven Member States (BE, DK, DE, IT, NL, AT, PT, RO, SI, FI and SE) are expected to contribute with bioliquids in final renewable energy of the EU.

Finland is expected to have the highest absolute contribution with 3021.1 ktoe (126.5 PJ), equivalent to almost half of total bioliquids expected to be consumed in this year in the EU for energy purposes. Portugal is expected to reach the second absolute contribution with 932 ktoe (39 PJ) whereas the Germany will follow with 835.7 ktoe (35 PJ). Bioliquids is expected to be consumed totally for electricity purposes in Austria, whereas in Italy this ratio will reach 73.6%.

The Netherlands, Romania and Slovenia have planned to use this biomass subcategory only for heat/cold purposes in 2020. The highest share of bioliquids in final biomass use and final renewable energy are expected to be found in Finland (39.1% and 28.2%), Portugal (35.5% and 15.4%) and the Netherlands (19.7% and 7.9%).

8.5.1 Bioliquids electricity

8.5.1.a. Installed capacity

Bioliquids installed capacity in the EU increased in 2005-12 with a CAGR of 26%, reaching the level of 1856 MW[19]. The penetration of bioliquids in final biomass capacity in 2012 reached 4.6% from 2.3% in the baseline year. The share of bioliquids in renewable electricity capacity in 2012 increased to 0.4% from 0.2% in the baseline year. In 2020 the bioliquids

[19] In 2012 the Netherlands reported an installed capacity for bioliquids of 528 MW which is included in the EU final bioliquids installed capacity. Because this MS did not report on the electricity produced from this biomass subcategory and for the consistency of the calculations the reported capacity from Netherland is not taken in consideration in the results presented in this section. Without the Netherland bioliquids capacity the EU 2012 total installed capacity of bioliquids used in this section was **1328 MW**.

installed capacity is expected to reach 1711 MW contribution in biomass installed capacity and renewable electricity capacity respectively by 3.9% and 0.4%.

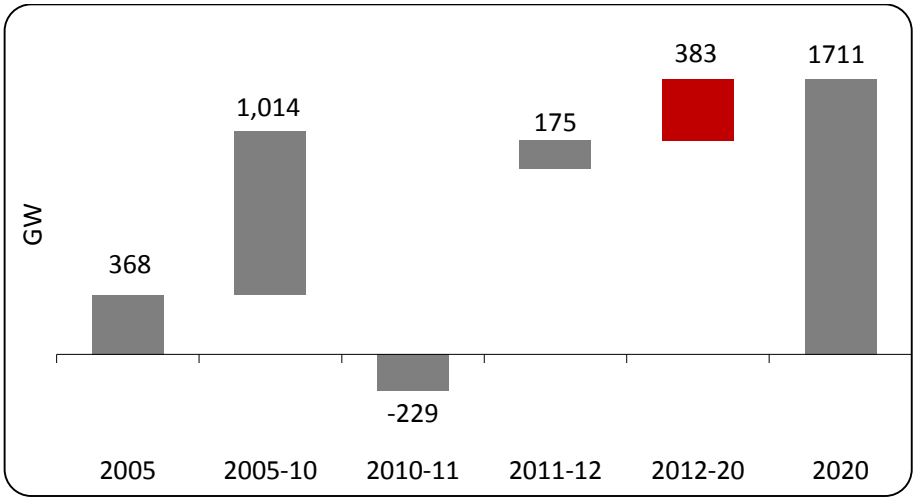

Figure 56. Bioliquids installed capacity progress in the EU, 2005-2020

Only 6 Member States (BE, DE, IT, NL, AT and SE[20]) reported on bioliquids installed capacity in the EU in 2012. Although not planned, the Netherlands reported since 2009 an installed capacity for bioliquids equal to 17 MW. Even Sweden had no plans to use the bioliquids in electricity sector but in 2012 it reported a capacity of 528 MW. The expected bioliquids capacities for Denmark (26 MW) and Portugal (435 MW) were not reached in 2012 while Belgium, Germany and Italy exceeded in the expected capacities for this year. Italy had in 2012 the highest penetration of bioliquids in biomass capacity with 27.8% followed by Sweden (13%), Belgium (6.3%), Germany (4.2%) and the Netherlands (1.4%). The shares of bioliquids capacity in total renewable electricity capacity reached 2.3% in Italy and 2.2% in Sweden.

According to the NREAPs in 2020 Italy is expected to have installed 980 MW of bioliquids capacity, followed by Portugal with 435 MW, Germany with 237 MW, Denmark with 26 MW and Belgium with 18 MW.

8.5.1.b. Contribution to renewable electricity

Renewable electricity from bioliquids in the EU reached 3228 GWh (11.6 PJ) in 2012 increasing with a CAGR of 11.9% between 2005 and 2012. Bioliquids contribution to renewable electricity was very marginal in 2012 with a share of 0.4%, whereas in biomass electricity this subcategory provided a contribution of 2.3%. The fastest increase of bioliquids use in electricity sector took place between 2005 and 2010 with a CAGR of 34%.
In 2020 the absolute contribution of bioliquids to renewable electricity is expected to reach 12746.8 GWh (45.9 PJ) developing with a CAGR of 18.7% (almost 6 times higher than the expected average growth rate). The contribution of bioliquids in biomass electricity is expected to increase four times, almost reaching 9% whereas the penetration in renewable electricity will be only 1%.

[20] See Footnote 19.

More than 90% of renewable electricity in the EU from bioliquids was found in Italy with 2977 GWh (10.7 PJ) followed by Germany with 250 GWh (0.9 PJ).

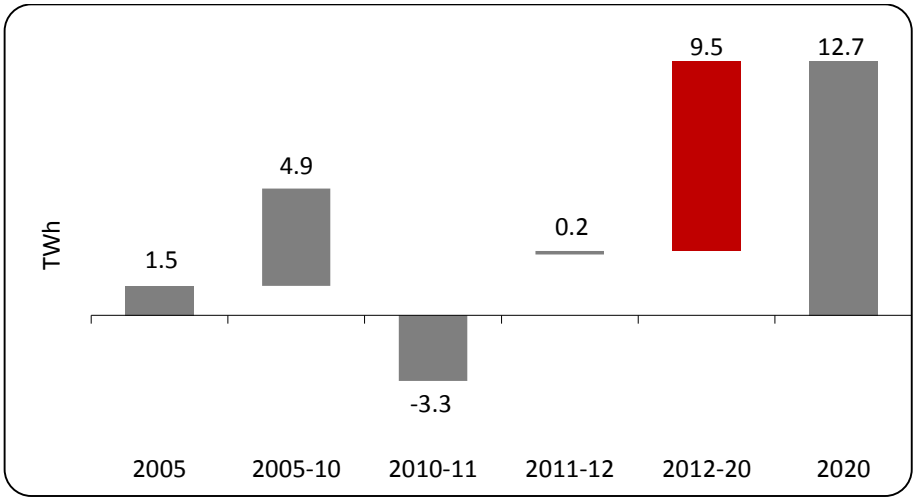

Figure 57. Bioliquids renewable electricity progress in the EU, 2005-2020

Although not planned, Latvia and Cyprus reported on the use of bioliquids for electricity purposes respectively 0.8 GWh and 0.2 GWh. Belgium, the Netherlands, Austria and Sweden did not report any renewable electricity from bioliquids for period 2011-12 even if they have reported on installed capacity for this biomass subcategory. According to NREAPs, the main contribution from bioliquids to electricity sector was expected from Finland (4390 GWh) but no final electricity from this biomass subcategory was reported for 2011-12. The highest penetration of bioliquids in final renewable electricity in 2012 was found in Italy with 3.5% while for Germany this figure was only 0.2%.

In 2020, among the 8 Member States that are expected to contribute to the EU bioliquids use for electricity purposes, Italy is expected to be the leading country with 4860 GWh (17.5 PJ) followed by Finland[21] with 4780 GWh (17.2 PJ), Portugal with 1523 GWh (5.5 PJ), Germany with 1450 GWh (5.2 PJ) and Sweden with 65 GWh (0.2 PJ).

In 2020, the highest shares of bioliquids in their final renewable electricity is expected to be reached in Finland with 14.3%, Italy with 4.9%, Portugal with 4.3%, Germany with 0.7% and Belgium with 0.1%. Portugal is expected to have the highest share of bioliquids in its biomass used in electricity sector with 47.7% followed by Finland with 44.1% and Italy with 39.2%.

8.5.2 Bioliquids heating/cooling

The use of bioliquids for heat/cold purposes reached in 2012 only 227 ktoe (9.5 PJ), 5 times lower than the baseline level of 1172 ktoe (49.1 PJ) decreasing between 2005 and 2012 with a CAGR of -20.9%. Its penetration to the renewable heat and biomass used for heat/cold purposes was in 2012 very marginal with 0.3%. Between 2005 and 2010 bioliquids for heat/cold developed with a CAGR of 12.9% whereas period 2010-2011 experienced a

[21] In its NREAP Finland didn't report on the expected 2020 bioliquids installed capacity.

decrease with a negative CAGR of 88.8% followed then from a further decrease between 2011 and 2012 with a CAGR of -6.7%.
In 2020 the use of bioliquids in heating/cooling sector in the EU is expected to reach 4998 ktoe (209.3 PJ) increasing with a CAGR of 47.2%, 18 times higher than the planned CAGR. The share of bioliquids in final renewable heat expected for 2020 will reach 4.5% contributing to 6.9% of the biomass expected to be consumed in this sector.

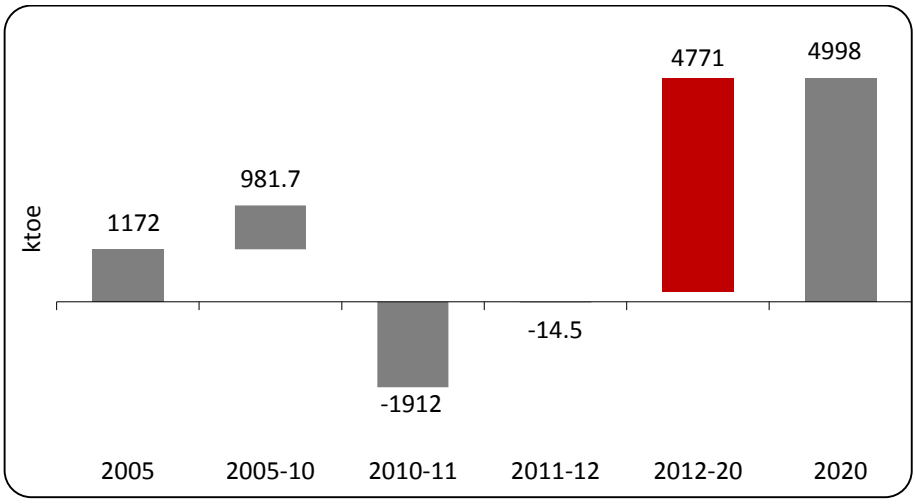

Figure 58. Bioliquids renewable heating/cooling progress in the EU, 2005-2020

Only 5 Member States (DK, DE, IT, LV and FI) reported on the contribution of bioliquids in heating/cooling sector in year 2012. The highest contribution in 2012 was coming from Germany, accounting for almost 75% (170 ktoe or 7.1 PJ) of the whole EU. The share of bioliquids in final biomass consumed for heat/cold purposes in the EU reached the highest figure in Germany with 1.7% contribution equivalent to a share of 1.5% in final renewable heat.

In 2020, the number of Member States expected to report on bioliquids heat will double from 2012 (BE, DK, DE, IT, NL, PT, RO, SI, FI and SE). The highest absolute contributions are expected to be Finland with 2610 ktoe (109.3 PJ), Portugal with 801 ktoe (33.5 PJ), Germany with 711 ktoe (29.8 PJ), the Netherlands with 582 ktoe (24.4 PJ), and Italy with 150 ktoe (6.3 PJ). Leading Member States in the share of bioliquids in the renewable heat are expected to become Finland with 35.9%, Portugal with 32.0%, the Netherlands with 26.7%, Germany with 4.9% and Slovenia with 4.5%. Bioliquids will contribute with more than 75% in biomass expected to be used in this sector in the Netherlands whereas in Portugal and Finland this contribution is expected to reach respectively 43.6% and 41%.

8.6 Biomass used in households

Biomass use in households for heating/cooling purposes (bioheat-house) made in 2012 almost 54% of biomass used for heat/cold purposes in the EU, amounting to 39.1 Mtoe (1636.6 PJ), increasing with a CAGR of 4.6% between 2005 and 2012. This development was faster than planned exceeding by +9.6% (+3439.3 ktoe) the expected figure for 2020. Energy from household biomass accounted for the 47.7% of final renewable heat and 24.7% of final renewable energy consumed in the EU in 2012. The fastest development of the use of

biomass in households took place during 2011-2012 with a CAGR of 8.6% comparing with periods 2005-2010 (CAGR of 6.1%) and 2010-2011 (CAGR of -3.6%). According to the aggregated NREAPs the expected bioheat-house in 2020 will be 35.7 Mtoe (1492.5 PJ). The shares of this biomass category in final bioheat and renewable heat in 2020 is expected to be respectively 39.4% and 31.9% whereas 14.6% of final renewable energy in the EU is expected to be in the form of biomass in households.

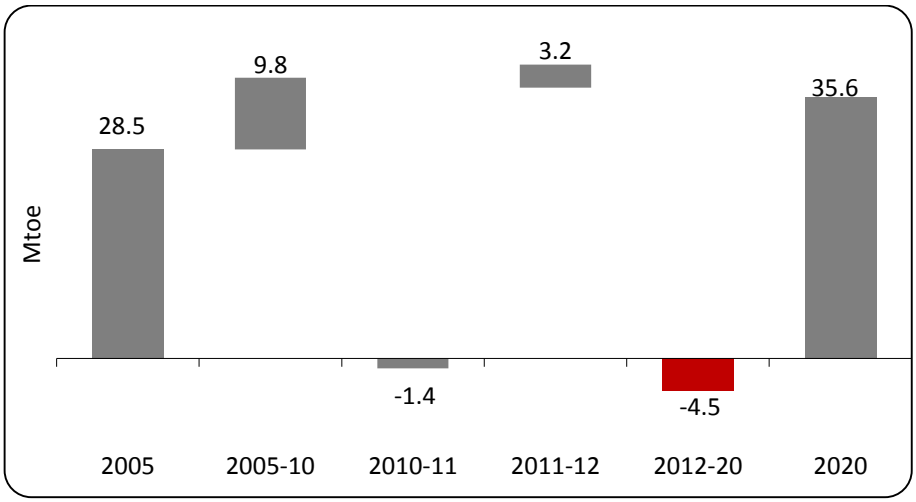

Figure 59. Biomass use in households progress in the EU, 2005-2020

15 Member States (BE, DE, EE. IE, EL, ES, LT, HR, NL, PL, PT, RO, SI, FI and SE) consumed more biomass in households in 2012 than their 2020 plans. Only Malta has no plans for bioheat-house while, although not planned, Poland has introduced it since in 2009.

France reported the highest use of bioheat-house in 2012 with 7.2 Mtoe (299.6 PJ) followed by Germany with 6.4 Mtoe (267.8 PJ), Italy with 3.6 Mtoe (151.5 PJ), Romania with 3.3 Mtoe (137.5 PJ) and Poland with 2.8 Mtoe (116.8 PJ). The contribution of these five Member States covered in 2012 almost 60% of the whole EU use.

In 2012 Croatia and Romania used almost 90% of bioheat in households. This share for the same year reached nearly 86% in Slovenia and 80% each in Italy and Greece. The shares of biomass-house final renewable energy reached 63.6% in Romania, 51% in Lithuania, 49.2% in Estonia, 49.1% in Hungary and 46.7% in Slovenia.

In 2020, leading Member States in bioheat-house are expected to be France with 7400 ktoe (309.8 PJ), Germany with 5975 ktoe (250.2 PJ), Italy with 3620 ktoe (151.6 PJ), Austria with 2905 ktoe (121.6 PJ), and Romania with 2676 ktoe (112.0 PJ). These five leading countries will sccount for about 22576 ktoe (945.2 PJ) in bioheat-house, representing about 63.9% of the whole EU.

In 2020, Bulgaria will show the larger share of bioheat-house in final renewable energy are with 49.5%, followed by Latvia with 41.4%, Estonia with 38.8%, Romania with 37% and Czech republic with 33.3%. Similarly Bulgaria is expected to have in 2020 the highest share bioheat-house in bioheat with 94.3% followed by Austria with 80.5%, Hungary with 77.4%, Slovenia with 75% and Italy with 63.8%.

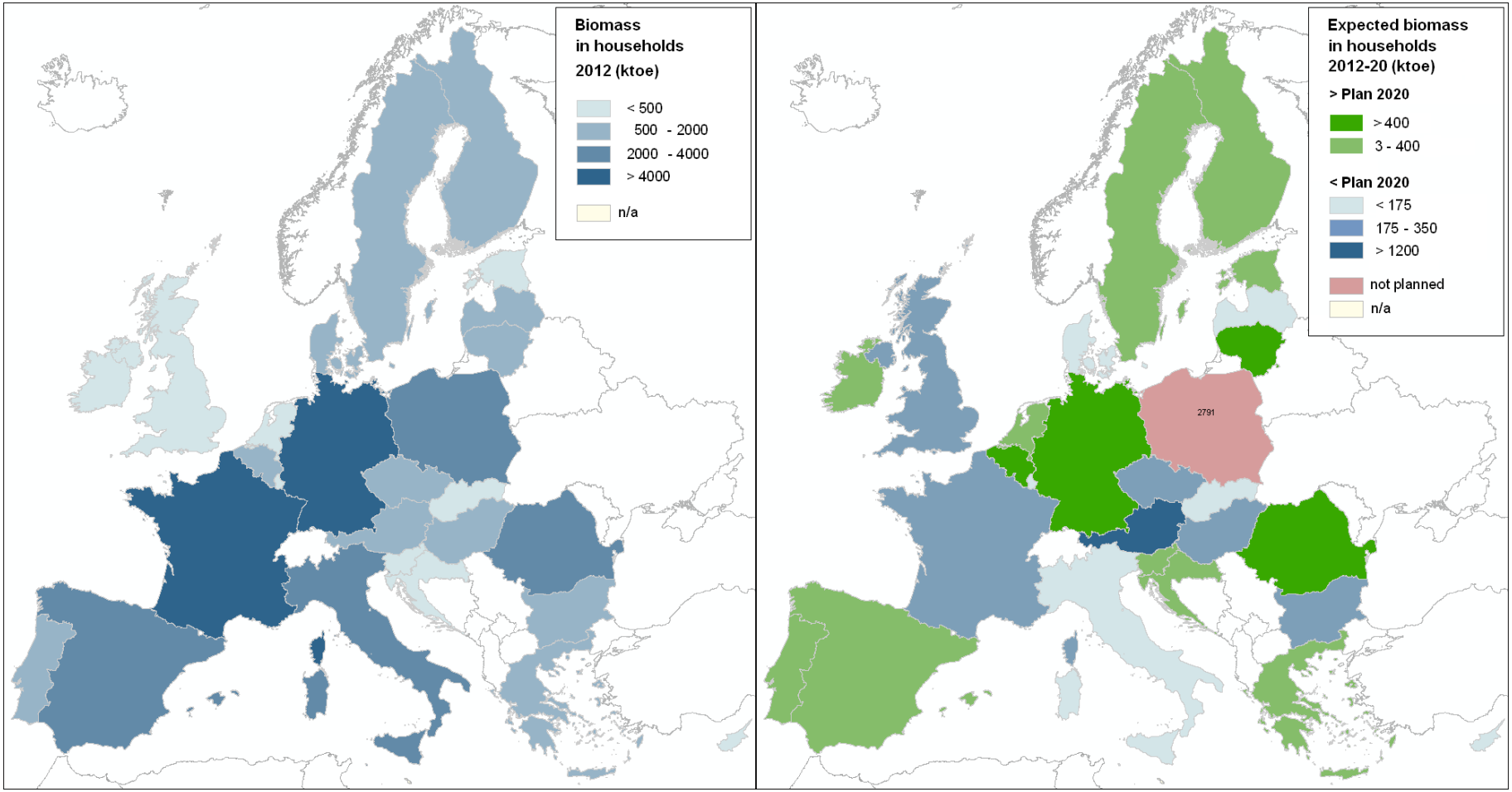

Figure 60. Biomass use in households in each EU MS, 2012 (left) – gap to 2020 (right)

9. Biofuels

Biofuels use in transport sector in the EU increased annually by 21.8% between 2005 and 2012 reaching almost 12 Mtoe (499.6 PJ). The share of biofuels in final renewable energy in the EU reached 7.5% from 2.9% in the baseline year. The fastest increase of biofuels use in transport sector took place between 2005 and 2010 with a CAGR of 35%. Nevertheless this development was slower than expected missing the expected NREAP 2012 figure by 28.6% (-4.8 Mtoe). Due to this slow development biofuels use in transport sector are expected to increase faster than planned, with a CAGR of 11.8% up to 2020 in order to reach the absolute contribution of 29.1 Mtoe (1216.4 PJ). The share of biofuels in final renewable energy in the EU in 2020 is expected to reach almost 12%.

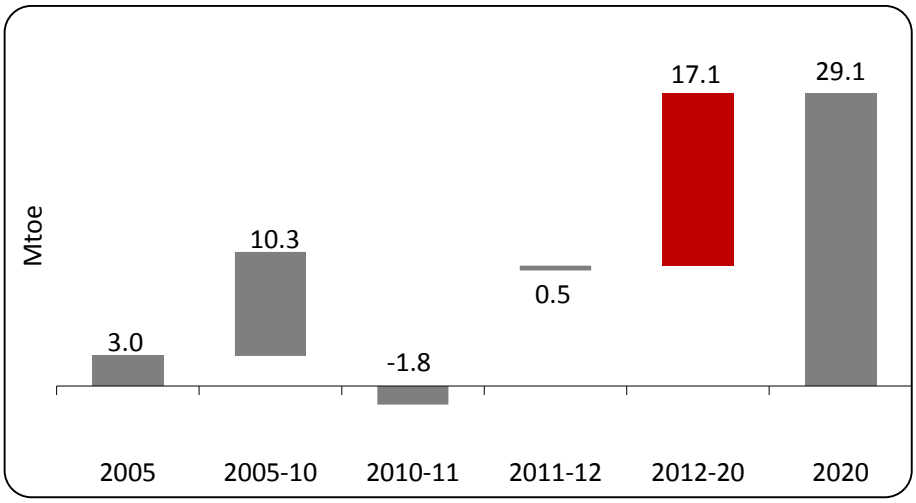

Figure 61. Biofuels progress in the EU, 2005-2020

Only 6 Member States (IT, LU, HR, SI and SE) met or exceeded the respective NREAPs plans in 2012. Due to sustainability requirements laid down in Article 17 of RED Bulgaria, Estonia and Spain did not report on biofuels used in transport sector for period 2011-12.

The five leading Member States in 2012 in biofuels use in transport sector in the EU were Germany with 2943 ktoe (123.2 PJ), France with 2842 ktoe (119 PJ), Italy with 1365 ktoe (57.1 PJ), United Kingdom with 882 ktoe (36.9 PJ) and Poland with 790 ktoe (33.1 PJ), together accounting for almost 74% of final biofuels use in the EU.

The highest share of biofuels in final renewable energy in 2012 was found in Luxembourg (36%), Malta (27.2%), United Kingdom (15.9%), Belgium (14.2%) and Cyprus (14.1%). Malta had in 2012 the highest share of biofuels in bioenergy with almost 70% followed by Cyprus with 45.6%, Luxembourg with 43%, United Kingdom with 27.7% and Ireland with 26%.

In 2020, the leading countries in biofuel use in transport are expected to be Germany with 5473 ktoe (229.1 PJ), United Kingdom with 4205 ktoe (176.1 PJ), France with 3660 ktoe (153.2 PJ), Spain with 113.6 PJ (2713 ktoe) and Italy with 105.9 PJ (2530 ktoe). The highest shares of biofuels in final renewable energy are expected to be found in Luxembourg (55.2%), Malta (22.2%), Ireland (21.2%), United Kingdom (20.5%) and Poland (18.5%).

9.1 Bioethanol/bio-ETBE

Bioethanol/bio-ETBE use in transport sector in the EU reached 2575 ktoe (107.8 PJ) in 2012 increasing with a CAGR of 25.1% from the baseline level of 537.8 ktoe (22.5 PJ). The share of bioethanol/bio-ETBE in total biofuels used in the transport sector reached 21.6% in 2012 from 17.9% in year 2005. Its share in final renewable energy use in transport sector in the EU increased from 13.2% in the baseline year to 19.4% in 2012. The penetration of bioethanol/bio-ETBE in final renewable energy in 2012 was 1.6%, i.e., the triple of its contribution in 2005. The fastest increase of the use of bioethanol/bio-ETBE took place between 2005 and 2010 with a CAGR of 38.4%. Up to 2020 bioethanol/bio-ETBE use is expected increase with a CAGR of 14% in order to reach the value of 7323.6 ktoe (306.6 PJ), providing a 25.2% and 22.7% share of biofuels and renewable energy use in transport sector, respectively. The penetration of bioethanol/bio-ETBE in final renewable energy in 2020 is expected to be increased up to 3%.

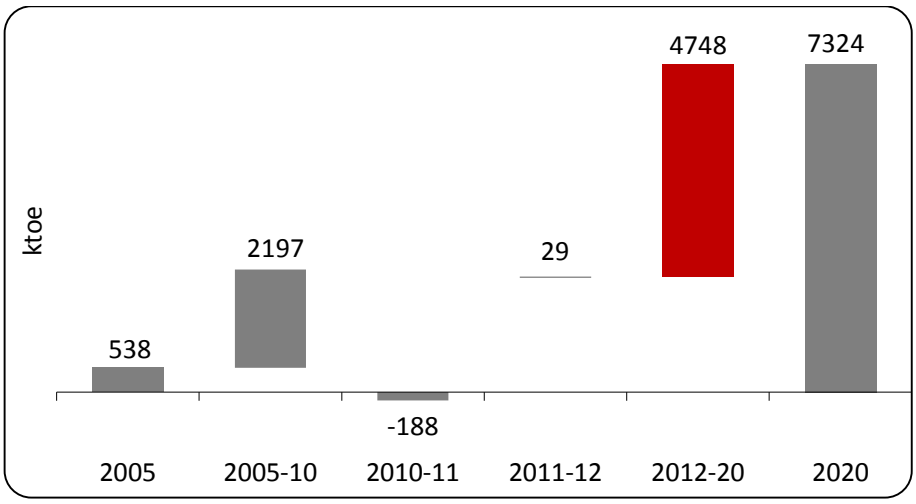

Figure 62. Bioethanol/bio-ETBE progress in the EU, 2005-2020

The leading Member States in year 2012 in bioethanol/bio-ETBE use in transport sector were Germany with 792 ktoe (33.2 PJ), France with 418 ktoe (17.5 PJ), United Kingdom with 387 ktoe (16.2 PJ), Sweden with 197 ktoe (8.3 PJ) and Poland with 193 ktoe (6.4 PJ), together providing more than two-third of EU use. Finland had the highest share of bioethanol/bio-ETBE in biofuels use in transport sector in year 2012 with 45.4% followed by United Kingdom (43.9%), the Netherlands (39%), Ireland (34.1%), Latvia (29.8%) and Germany (26.9%). The highest penetration in final renewable energy in year 2012 was found in United Kingdom with 7% followed by the Netherlands with 5.3%, Ireland with 3.7% and Hungary with 2.3%.

Only 4 Member States (BE, AT, SI and UK) reported in 2012 a use of bioethanol/bio-ETBE in transport sector higher than planned. Croatia, Cyprus and Portugal have planned to introduce the use of this biofuel subcategory in transport sector respectively in 2013, 2014 and 2015 and, consistently, did not report any use up to 2012. On the contrary, although planned, Bulgaria, Denmark, Greece, Estonia and Malta did not report any use of bioethanol/bio-ETBE for period 2011-12.

In 2020, the leading countries in bioethanol use in transport are expected to be UK with 1743 ktoe (73 PJ), Germany with 857 ktoe (35.9 PJ), France with 650 ktoe (27.2 PJ), Italy with 600 ktoe (25.1 PJ) and Sweden with 465 ktoe (19.5 PJ). The highest share of bioethanol/bio-ETBE in their final use of biofuels is expected to be found in Greece (67.1%), Hungary (59.5%), Sweden (57.4%), Malta (45.2%) and Estonia (42.5%). The highest penetration of bioethanol/bio-ETBE in their 2020 final renewable energy is expected to be found in Hungary (10.6%), Malta (10%), United Kingdom (8.5%), Greece (8.3%), Cyprus (5.6%) and Poland (4.2%).

9.2 Biodiesel

The use of biodiesel in transport sector increased between 2005 and 2012 with a CAGR of 21.7%, from 2257.8 ktoe (94.5 PJ) in 2005 to 8938 ktoe (374.2 PJ) in 2012. Almost three-fourth of biofuels used in transport sector in the EU in 2012 was in the form of biodiesel and its share in final renewable energy consumed in transport sector and final renewable energy in the EU reached in 2012 the figures of 67.4% and 5.7% respectively. Between 2005 and 2012 bioediesel use in transport sector increased with a CAGR of 35.6% whereas during 2010-2011 this use decreased with a CAGR of 16%. In 2020 the use of biodiesel in transport sector is expected further increase with a CAGR of 11.3% in order to reach the planned amount of 20983.2 ktoe (878.5 PJ). Despite of this absolute increase, the share of biodiesel in final biofuels use expected in 2020 will decrease to 72.2%. Its share in final renewable energy in 2020 will also decrease reaching 65% whereas its contribution in final renewable energy is expected to increase to 8.6%.

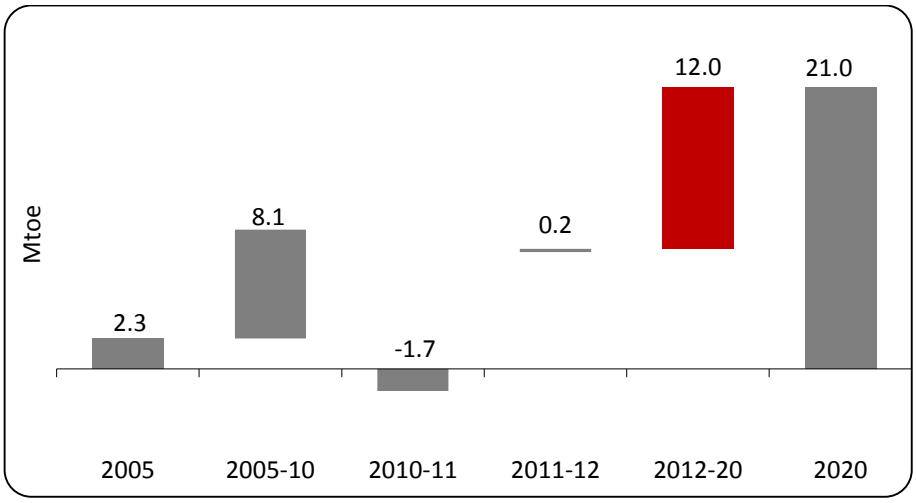

Figure 63. Biodiesel progress in the EU, 2005-2020

The leading Member States in biodiesel in year 2012 were France with 2424 ktoe (101.5 PJ), Germany with 2034 ktoe (85.2 PJ), Italy with 1262 ktoe (52.8 PJ), Poland with 635.6 ktoe (26.6 PJ) and United Kingdom with 471 ktoe (19.7 PJ) with a cumulated contribution of 76.4% of the whole EU.

Greece, Cyprus, Croatia, Malta and Portugal used only biodiesel in transport sector in year 2012 while the share of biodiesel in biofuels used in transport sector in other Member States in year 2012 ranged from 53.4% (United Kingdom) to 97.9% (Luxembourg).

The highest penetration of biodiesel in final renewable energy in year 2012 was found in Luxembourg (35.2%), Malta (27.2%), Cyprus (14.1%), Belgium (12.2%) and France (11.1%).

Although planned, Bulgaria, Denmark, Estonia and Spain did not report biodiesel use in transport sector while 7 Member States (FR, IT, LU, MT, AT, SI and SE) reported in 2012 biodiesel use higher than planned.

In 2020, leading countries in biodiesel are expected to be Germany with 4443 ktoe (186 PJ), France with 2850 ktoe (119.3 PJ), UK with 2462 ktoe (103.1 PJ), Spain with 2313 ktoe (96.8 PJ) and Italy with 1880 ktoe (78.7 PJ). These five countries together are expected to use 584.0 PJ of biodiesel in the transport sector, representing 78.7% of the EU total.

The highest share of biodiesel in biofuels will be found in Portugal (94.3%), Slovenia (90.4%), Luxembourg (89.3%), Belgium (88.4%) and Spain (85.3%).

Luxembourg is expected to have in 2020 the highest penetration of biodiesel in final renewable energy with 49.3% followed by Ireland with 15.1%, Poland 13.7%, Belgium 13% and Slovenia 12.9%.

9.4 Other biofuels

The use of other biofuels (biogas, vegetable oils etc.) in the transport sector has increased since 2005 with a CAGR of 1.5% reaching 220.4 ktoe (9.2 PJ) in 2012 from the 198.5 ktoe (8.3 PJ) in the baseline year. In 2012, this biofuels subcategory contributed with 1.8% to the final use of biofuels in transport sector, a contribution much lower than the 6.6% in the baseline year. The use of other biofuels in transport sector experienced the fastest increase during period 2011-2012 with a CAGR of 120% comparing with periods 2005-2010 (CAGR of -1.2%) and 2010-2011 (CAGR of -46.3%).
Up to 2020 the other biofuels are expected to further increase by a CAGR of 16.5% in order to reach the planned level of 746.8 ktoe (31.3 PJ). Nevertheless their contribution to biofuels in 2020 will reach 2.6% and their share in final renewable energy used in this sector will increase to 2.3% from 1.7% in 2012.

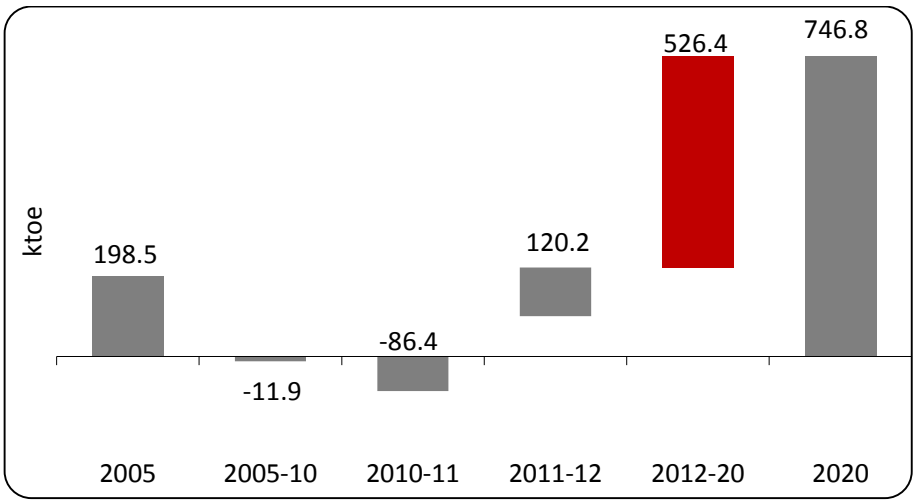

Figure 64. Other biofuels progress in the EU, 2005-2020

Only 6 Member States (DE, IE, FI, SE and UK) reported in 2012 on the use of other biofuels in transport sector. Germany had the leading position with 117 ktoe (4.9 PJ) followed by Sweden with 79 ktoe (3.3 PJ) and United Kingdom with 24 ktoe (1 PJ). The penetration of other biofuels in total biofuels used in transport sector in these 6 MS was the highest in Sweden with 13.7% followed by Germany (4%) and United Kingdom (2.7%).

In 2020 fifteen MS are expected to report a contribution on renewable energy in transport sector from other biofuels. In that year, the leading Member States are expected to be Germany with 173 ktoe (7.2 PJ), France with 160 ktoe (6.7 PJ), Austria with 94 ktoe (3.9 PJ), Sweden with 94 ktoe (3.9 PJ) and Poland with 66 ktoe (2.8 PJ). These five countries are expected to use about 587 ktoe (24.6 PJ) of other biofuels in transport sector, covering about 79.1% of such kind of biofuels in the EU.

9.5 Biofuels Article 21.2

Biofuels article 21.2 (wastes, residues, ligno-cellulosic material) amounted to 2186 ktoe (91.5 PJ) in 2012 developing with a CAGR of 81%, almost double of the expected 49.3%. The share of such biofuels in final use of biofuels in transport sector in 2012 reached 18.3% from only 1.2% in the baseline year whereas their share in final renewable energy use in this sector reached 16.5% from the very marginal of 0.8% in 2005. In 2012 more than 90% of Article 21.2 biofuels had the form of biodiesel and the rest of bioethanol/bio-ETBE (3.3%) and other biofuels (5.6%). In 2020 the absolute contribution of Article 21.2 biofuels is expected to amount to 2610.2 ktoe (109.3 PJ). Biodiesel is expected to account for 58% of Article 21.2 biofuels, the rest will be bioethanol/bio-ETBE (26%) and other biofuels (16%).

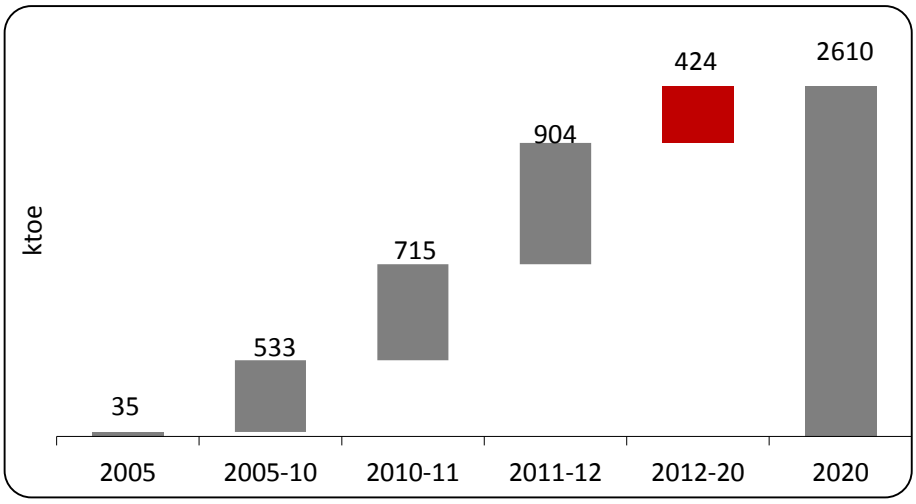

Figure 65. Biofuels Art.21.2 progress in the EU, 2005-2020

Sixteen Member States (DE, IE, EL, FR, IT, CY, LT, HU, MT, NL, PL, PT, SI, FI, SE and UK) reported on the use of Article 21.2 biofuels in their transport sector in year 2012. United Kindom leaded in this year with 472 ktoe (19.8 PJ) followed by Germany with 392 ktoe (16.4 PJ), Italy with 341 ktoe (14.3 PJ), the Netherlands with 194 ktoe (8.1 PJ) and Sweden with 183 ktoe (7.7 PJ) accounting for more than 72% of EU total article 21.2 biofuels. Even than planned Estonia did not use this type of biofuels in its transport sector in year 2012 whereas Cyprus, Hungary and Portugal used less than their respective plans for this year.

In 2020, leading countries in the use of Article 21.2 biofuels in transport are expected to be Germany with 406 ktoe (17.0 PJ), Italy with 400 ktoe (16.7 PJ), Czech Republic with 292 ktoe (12.2 PJ), Spain with 252 ktoe (10.6 PJ) and Poland with 242 ktoe (10.1 PJ). The five countries are expected to use about 1592 ktoe (66.6 PJ) in transport in 2020, representing 62.1% of the art 21.2 biofuels used in the EU.

9.6 Biofuels from import

Imported biofuels in the EU increased with a CAGR of 50% between 2005 and 2012 reaching 2900.5 ktoe (121.4 PJ) from the level of 171 ktoe (7.1 PJ) in 2005. 21.2% (615 ktoe) of biofuels imported in 2012 was in the form of bioethanol/bio-ETBE. The share of imported biofuels in total biofuels used in transport sector in 2012 was 24.3% with a penetration of 1.8% in final renewable energy in the EU the same year. In 2020 imported biofuels are expected to reach 10962 ktoe (459 PJ) increasing with a CAGR of 18%, double of what planned. Almost 30% of imported biofuels is expected to come from bioethanol/bio-ETBE. Its share in total biofuels in 2020 is expected to reach 37.7% with a penetration of 4.5% in final renewable energy in the EU.

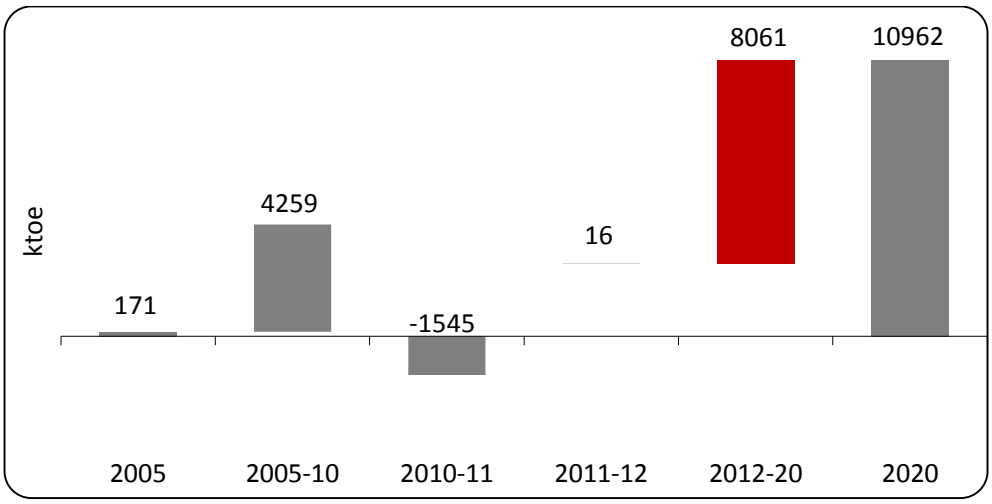

Figure 66. Imported biofuels progress in the EU, 2005-2020

Fourteen Member States (BE, IE, FR, IT, CY, LV, LT, LU, HU, AT, PL, RO, SI and UK) reported on the use of imported biofuels in their transport sector in 2012 and Italy and Austria used in 2012 more imported biofuels than planned for 2020.

Although not planned, Belgium, Lithuania, Hungary, Poland, Romania and Slovenia imported biofuels for their needs in transport sector in 2012.
For Belgium the imported biofuels were in the form of biodiesel only whereas for Poland imported only bioethanol/bio-ETBE. Other Member States imported in 2012 both types of biofuels.

Italy imported in 2012 the highest absolute amount of biofuels, 1054 ktoe (44.1 PJ) followed by United Kingdom with 651 ktoe (27.3 PJ), France with 436 ktoe (18.3 PJ), Austria with 288 ktoe (12.1 PJ) and Romania with 110 ktoe (4.6 PJ).

Luxembourg used in 2012 in transport sector only imported biofuels followed, in terms of fraction of biofuels imported, by Slovenia (98.2%), Italy (77.2%), United Kingdom (73.8%) and Latvia (73.5%).

In 2020, leading Member States in the use of imported biofuels in transport are expected to be UK with 3687 ktoe (154.4 PJ), Germany with 3124 ktoe (130.8 PJ), Italy with 1000 ktoe (41.9 PJ), the Netherlands with 516 ktoe (21.6 PJ) and France with 450 ktoe (18.8 PJ). These five countries are expected to use about 367.5 PJ (8777 ktoe) of imported biofules, representing 80.1% of the EU biofuels imports in that year.

According to their NREAPs, Denmark and Luxembourg are expecting to use in 2020 only imported biofuels in their transport sector whereas in Cyprus, United Kingdom and Malta the share of imported biofuels in total biofuels is expected to be respectively 98.4%, 87.7% and 75.4%.

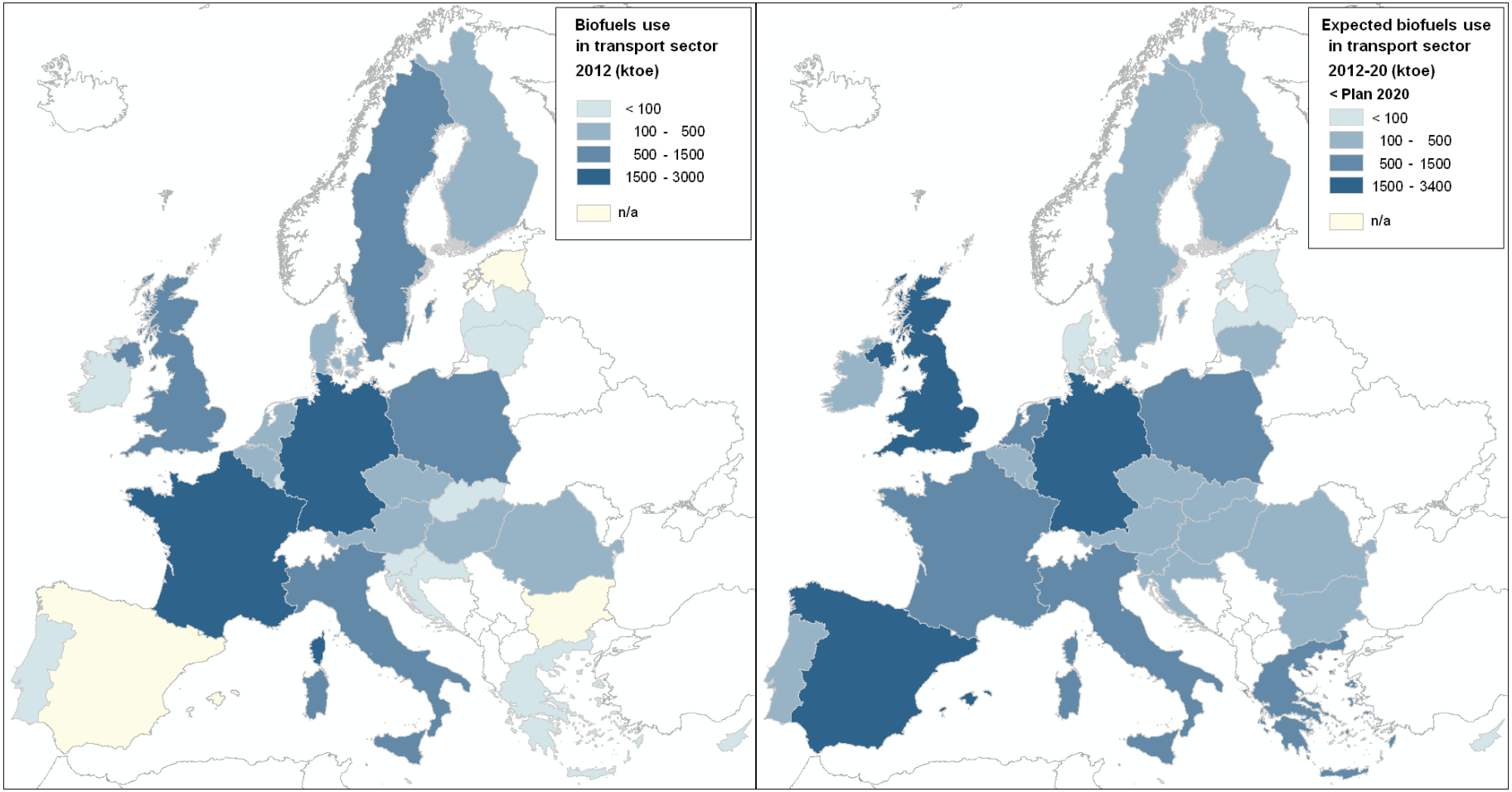

Figure 67. Biofuels use in transport sector in each EU MS, 2012 (left) – gap to 2020 (right)

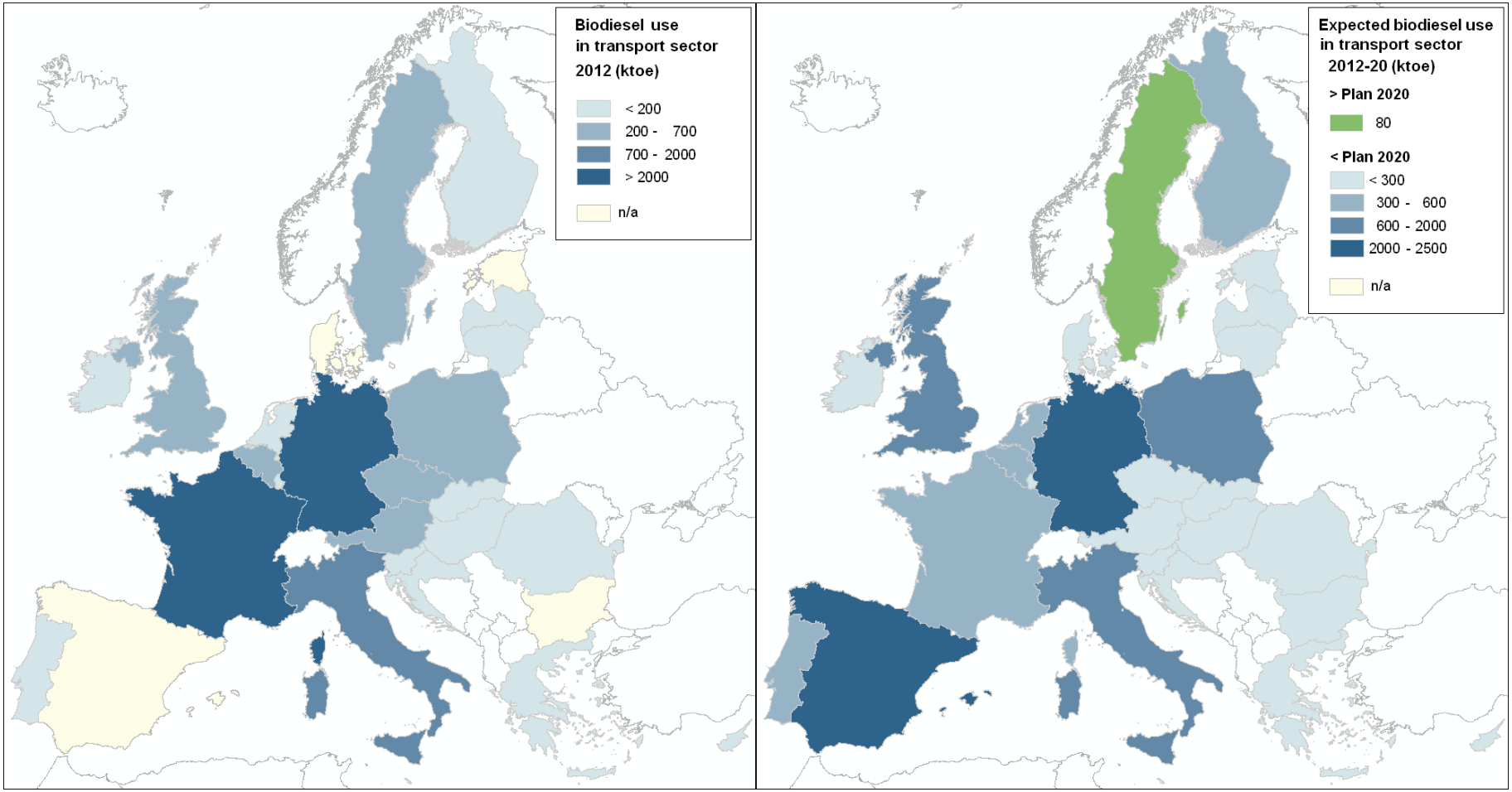

Figure 68. Biodiesel use in transport sector in each EU MS, 2012 (left) – gap to 2020 (right)

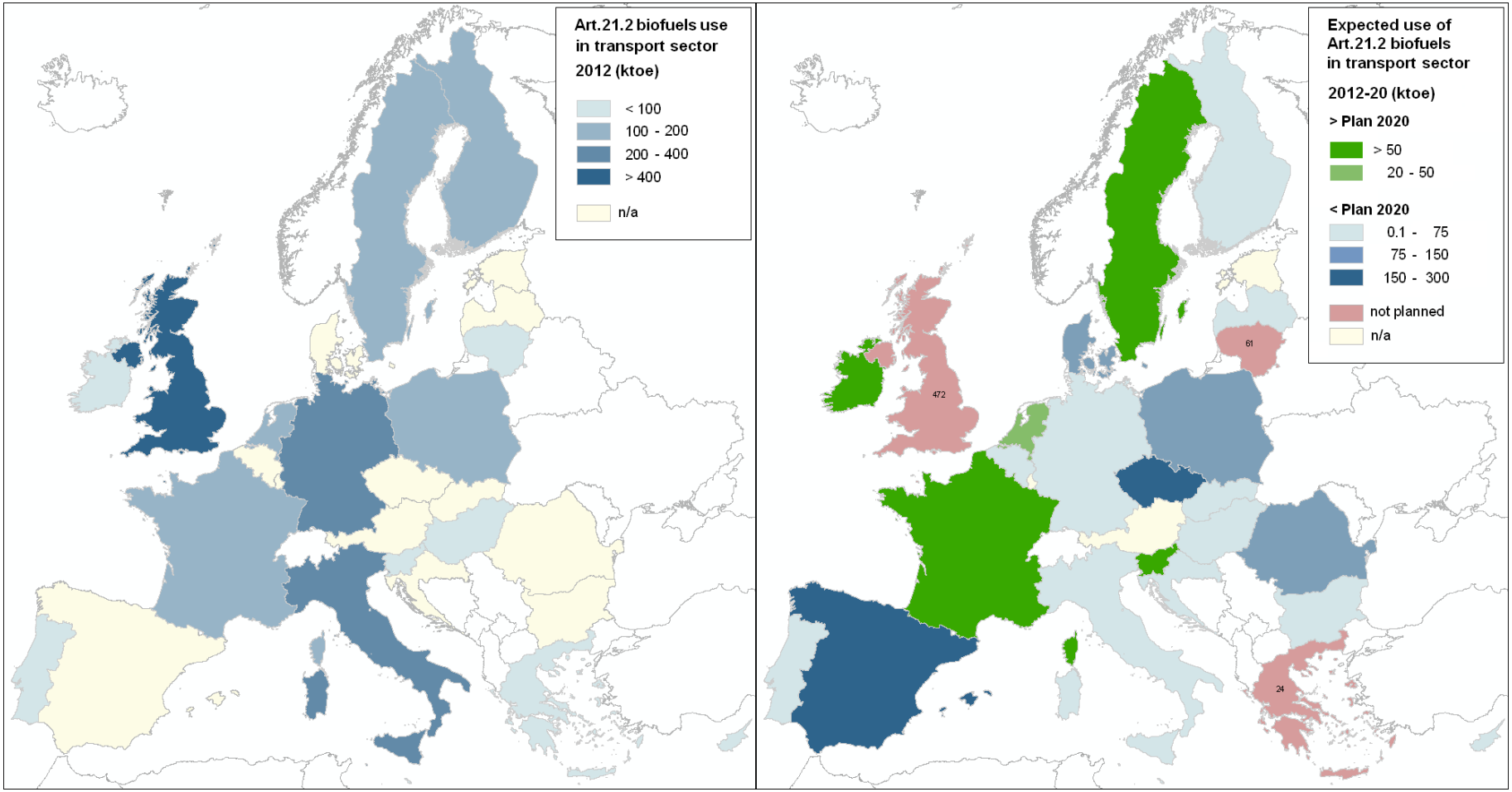

Figure 69. Article 21.2 biofuels use in transport sector in each EU MS, 2012 (left) – gap to 2020 (right)

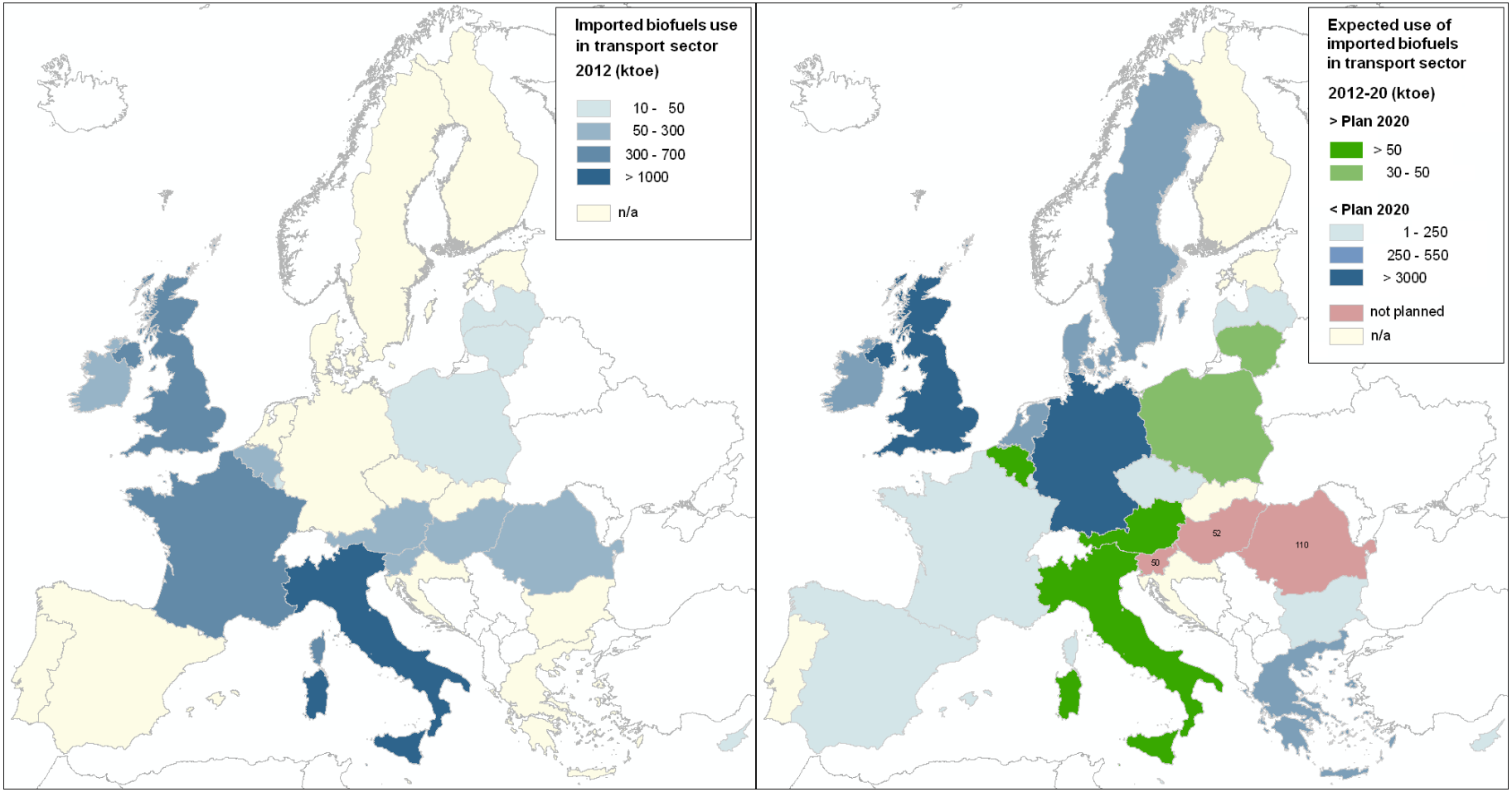

Figure 70. Imported biofuels use in transport sector in each EU MS, 2012 (left) – gap to 2020 (right)

10. Renewable electricity in transport sector

Renewable electricity in transport sector increased with a CAGR of 2.9% between 2005 and 2012, from 1094 ktoe (45.8 PJ) to 1332 ktoe (55.8 PJ), nevertheless its share in final use of renewable energy in transport sector decreased to 10% in 2012 from 26.5% in 2005. Renewable electricity used in transport sector provided a marginal contribution in final renewable energy in the EU in 2012 with 0.8%, mainly used (96.4%) in non-road transport.
Up to 2020 renewable electricity is expected to be developed with a CAGR of 11.8% in order to reach 3244.9 ktoe (135.9 PJ). The share of renewable electricity in final use of renewable energy in transport sector is expected to remain at the level of 10% whereas its contribution to final renewable energy is expected to reach 1.3%. The share of non-road transport uses of renewable electricity is expected to decrease to 77.8% in 2020.

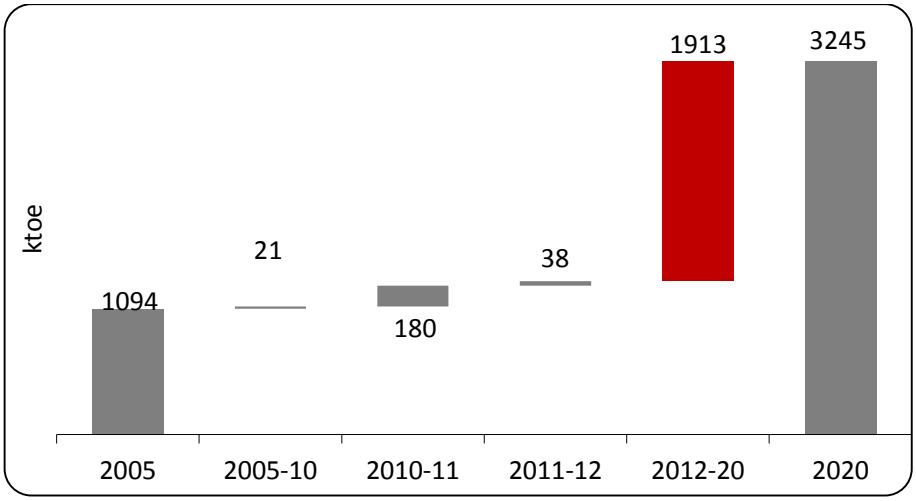

Figure 71. Renewable electricity in transport progress in the EU, 2005-2020

In 2012 three Member States (CY, MT and LT) did not report any use of renewable electricity in transport sector although planned by all three. Estonia and Poland reported in 2012 a value of renewable electricity in transport sector exceeding their 2020 plans.

Leading Member States in renewable electricity in transport in year 2012 accounting for two-third of such source in the EU were France with 209 ktoe (8.8 PJ), Germany with 188 ktoe (7.9 PJ), Italy with 186 ktoe (7.8 PJ), Austria with 173 ktoe (7.2 PJ) and Sweden with 129 ktoe (5.4 PJ).
The highest penetration of renewable electricity in final renewable energy used in transport sector in 2012[22] was found in Portugal (77.7%), Austria (29.4%), Croatia (23.8%), Latvia (17.9%) and Sweden (17.5%). Austria had in 2012 the highest penetration (2%) of renewable electricity used in transport in final renewable energy. Italy, Hungary and United Kingdom showed a penetration at the level of 1.2%.
In 2020 the leading Member States in the use of renewable electricity in transport sector are expecetd to be Germany with 667 ktoe (27.9 PJ), Spain with 502.6 ktoe (21 PJ), France

[22] For Bulgaria, Estonia and Spain the final renewable energy used in transport sector during period 2011-12 was composed by only renewable electricity since these MS didn't report on the use of biofuels that fulfilling the sustainability criteria in the transport sector for the same period.

with 402 ktoe (21 PJ), Italy with 369 ktoe (15.4 PJ) and Austria with 272 ktoe (11.4 PJ). Austria is expected to have the highest penetration of renewable electricity in final renewable energy used in transport sector with 31.8% followed by Sweden (19.6%), Spain (15.6%), Italy (12.7%) and Croatia (11.5%).

The penetration of renewable electricity use in transport in final renewable energy is expected to be the highest in Austria (2.9%), Luxembourg (2.7%), Spain (2.4%), Belgium (1.8%) and Italy (1.7%).

11 Renewable electricity from CHP

Renewable electricity from Combined Heat and Power (CHP) units amounted to 80.5 TWh (289.7 PJ) in 2012 increasing with a CAGR of 13.7% between 2005 and 2012. This contribution accounted for 10.8% of final renewable electricity consumed in the EU in the same year and 4.4% of final renewable energy use in the EU in year 2012. Up to 2020, renewable electricity from CHP units is expected to reach 125.7 TWh (452.6 PJ) or 10.4% of final renewable electricity expected to be consumed in the EU while maintaining unchanged its share in final renewable energy.

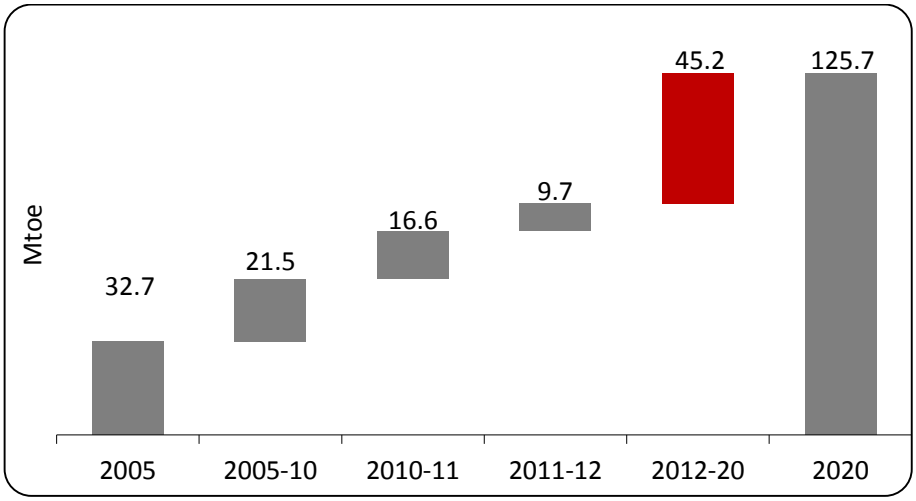

Figure 72. Renewable electricity in CHP progress in the EU, 2005-2020

In 2012, two Member States (Estonia and Poland) reported of renewable electricity from CHP already exceeding the 2020 plans and although Cyprus had not planned any contribution, it reported for 2012 50 GWh (4.3 PJ) in 2012. On the contrary, although that planned Spain, France, Lithuania and Hungary did not report any renewable electricity from CHP in 2012. No renewable electricity from CHP is expected in Malta up to 2020.

Almost of 70% of renewable electricity from CHP in the EU is consumed in Germany (19.1 TWh or 68.7 PJ), Sweden (12.2 TWh or 43.9 PJ), Poland (10.1 TWh or 36.3 PJ), Finland (9.6 TWh or 34.4 PJ) and Italy (5.2 TWh or 18.7 PJ).

The highest share of renewable electricity from CHP in final renewable electricity was found in Poland with 59.5%, Estonia 39.2%, Finland 39.1%, the Netherlands 37.9% and Czech Republic 35.3%. This type of renewable electricity had the highest penetration in final renewable energy in the Netherlands with 17.5% followed by Poland with 11.9% and

Finland with 9.2%.

In 2020 nearly 60% of the EU renewable electricity from CHP will be covered by Germany with 20.8 TWh (74.9 PJ), France with 17.2 TWh (61.8 PJ), Sweden with 16.7 TWh (60.3 PJ), Finland with 12.3 TWh (44.4 PJ) and Denmark with 8.8 TWh (31.8 PJ). In the same year, Hungary will show the highest share of renewable electricity from CHP (53.4%) in the final renewable electricity followed by Denmark (42.9%), Czech Republic (42.4%), Lithuania (41.3%) and Luxembourg (40.7%).

Denmark, Finland, the Netherlands and Czech republic are expecting to have the highest penetration of this type of renewable electricity in the final renewable energy in the EU in 2020 respectively with 15%, 9.9%, 9.7% and 9.3%.

12 Renewable heat in DH

In 2012 the EU used 8065 ktoe (337.7 PJ) of renewable heat in district heating systems, increasing from 5849.2 ktoe (244.9 PJ) in 2005. This development took place with a CAGR of 4.7% slightly slower than the expected one of 6.8%. In 2012 the EU used in district heating systems 9.8% of its renewable heat or 5.1% of its final renewable energy. In 2020 the use of renewable heat in district heating systems is expected to further increase with a CAGR of 10.3% in order to reach the planned level of 17704.5 ktoe (741.2 PJ). Shares in final renewable heat and final renewable energy are expected to be respectively 15.8% and 7.2%.

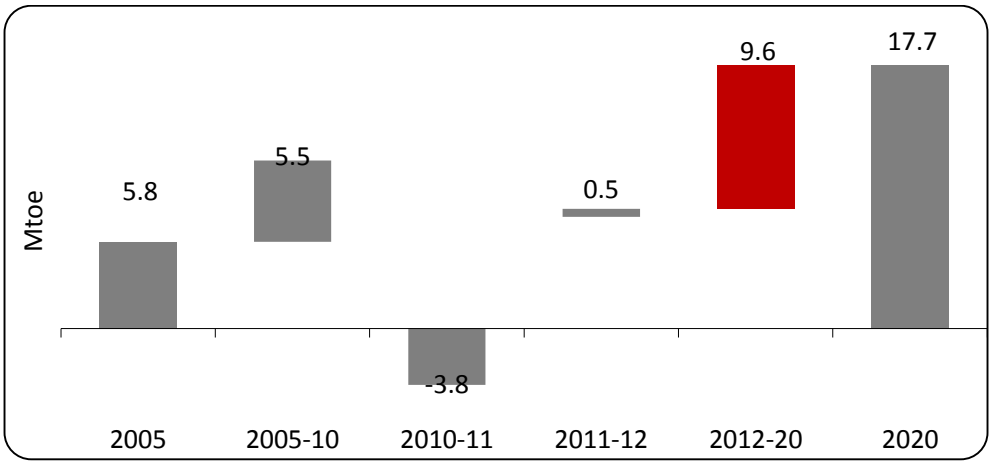

Figure 73. Renewable heat in DH progress in the EU, 2005-2020

Sixteen Member States (CZ, DK, DE, EE, IT, LV, LT, LU, HR, HU, NL, AT, RO, SK, FI and SE) reported on the use of renewable heat in their district heating systems in 2012 and two Member States in this group (namely Lithuania and Austria) exceeding already in 2012 their 2020 plan.

On the contrary, although planned, seven Member States (BE, BG, IE, ES, FR, SI and UK) did not report any use of renewable heat in their district heating systems for year 2012 while no reported values are expected in Cyprus, Malta, Poland and Portugal up to 2020.

In 2012, five Member States were together accounting for more than 80% of renewable heat in the EU: Sweden with 3050 ktoe (127.7 PJ), Denmark with 1301 ktoe (54.5 PJ),

Austria with 890 ktoe (37.3 PJ), Finland with 759 ktoe (31.8 PJ) and Germany with 641 ktoe (26.8 PJ).

In 2012 Denmark used in district heating 57.8% of its final renewable heat followed by Estonia (40.9%), Slovakia (33.1%), Sweden (31.6%) and Lithuania (26%).

The highest penetration of renewable heat used in district heating systems in final renewable energy in the EU in 2012 was found in Denmark (36.4%), Estonia (34.1%), Lithuania (22.1%), Sweden (16.3%) and Slovakia (15.6%).

In 2020 two-third of renewable heat expected to be used in district heating systems in the EU will be in France with a contribution of 3200 ktoe (134 PJ) followed by Sweden with 3141 ktoe (131.5 PJ), Germany with 2560 ktoe (107.2 PJ), Denmark with 1486 ktoe (62.2 PJ) and Romania with 1300 ktoe (54.4 PJ).

In the same year, Denmark with 49.1% together with Luxembourg (44.2%), Slovakia (43.9%), Estonia (40.9%) and the Netherlands (34.2%) are expected to have the highest penetration of district heating use in their final renewable heat while highest shares in final renewable energy will be found in Denmark (29.4%), Estonia (28.8%), Hungary (21.5%), Slovakia (21.2%) and Romania (18%).

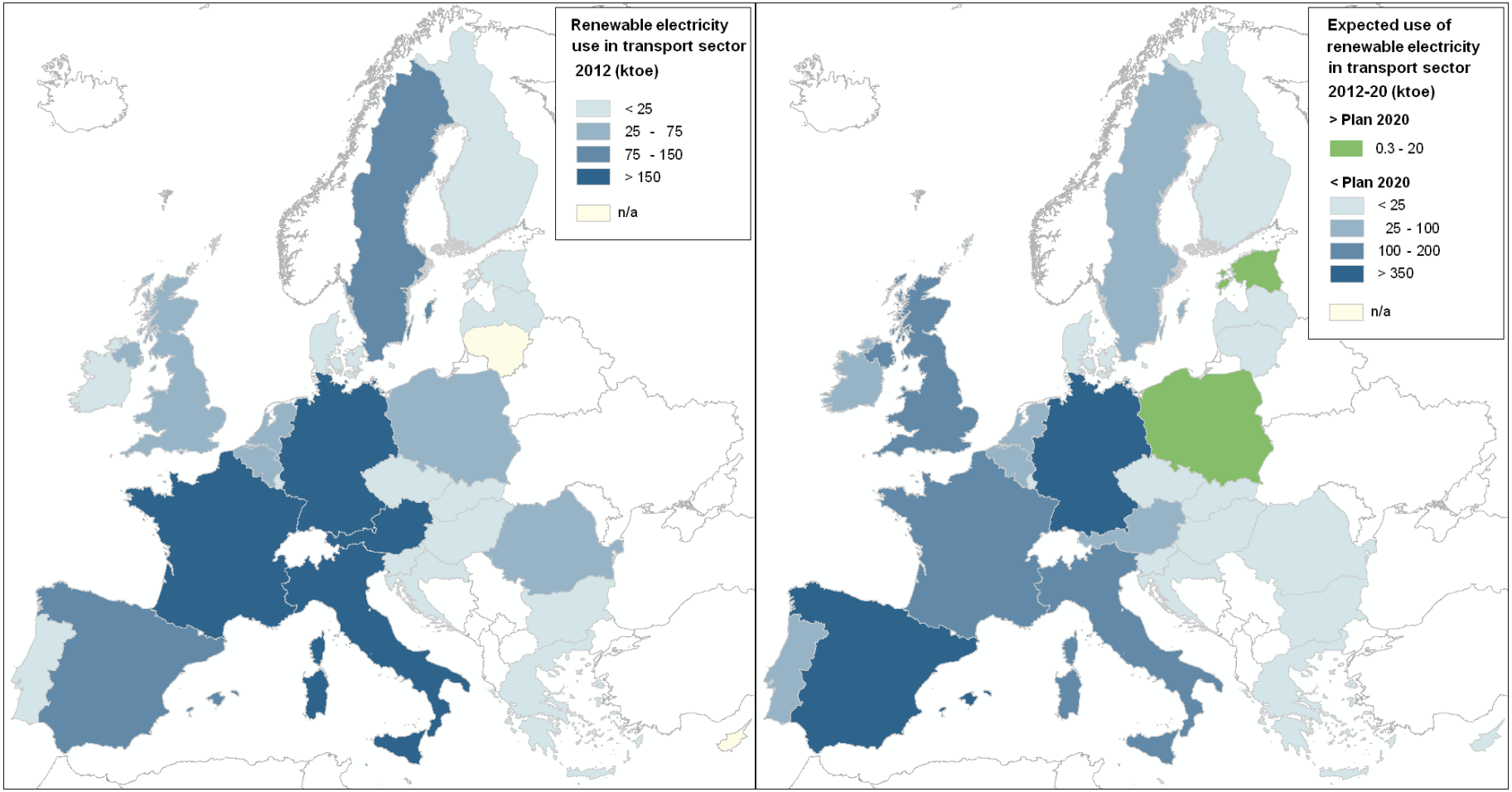

Figure 74. Renewable electricity use in transport sector in each EU MS, 2012 (left) – gap to 2020 (right)

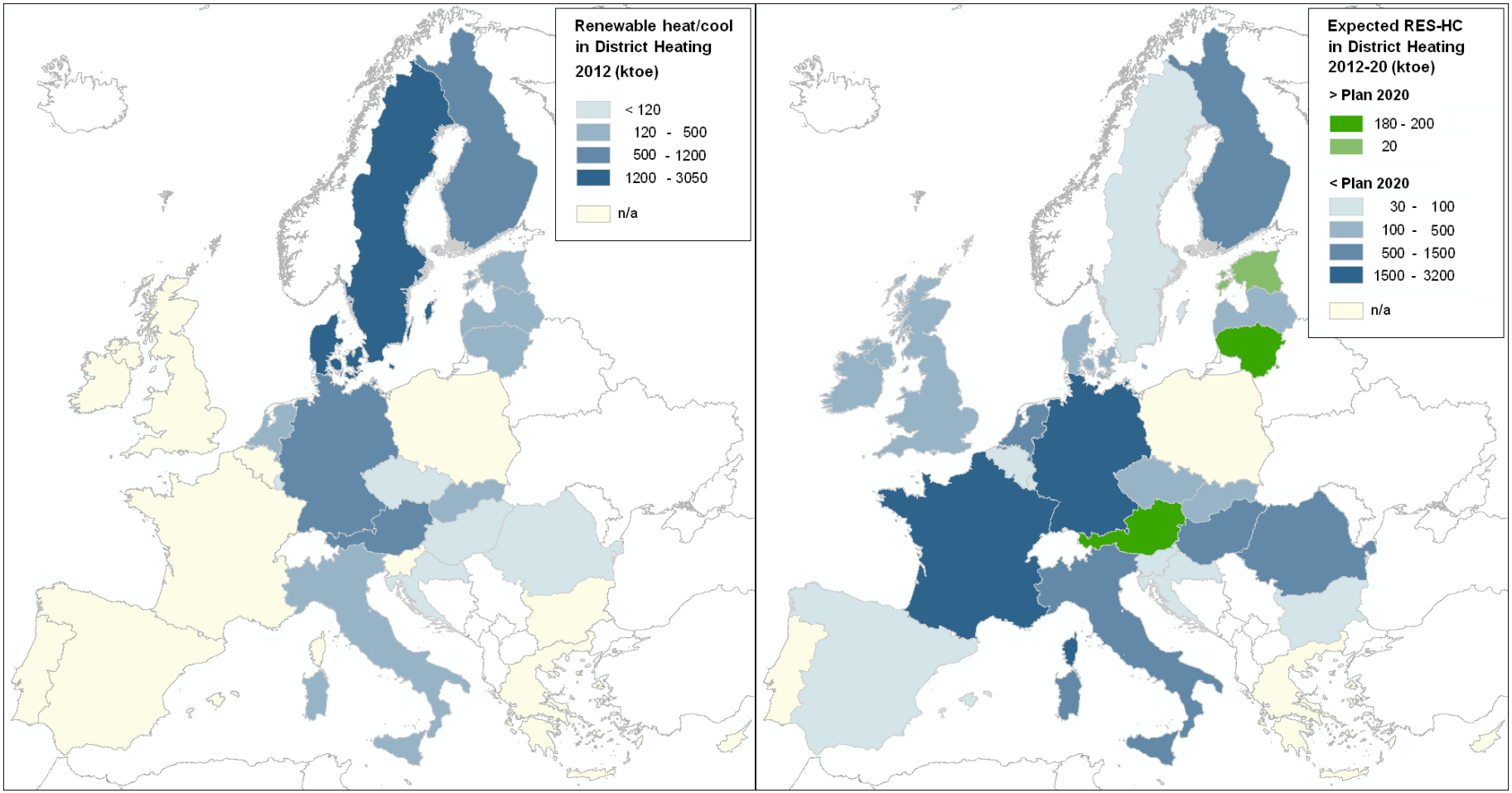

Figure 75. Renewable heat use in District Heating in each EU MS, 2012 (left) – gap to 2020 (right)

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Abbreviations

ETBE – Ethyl Tertiary Butyl Ether
GFEC – Gross Final Energy Consumption
GW – Gigawatt
GWh – Gigawatt-hour(s)
H/C – Heating /Cooling sector
ktoe – Kiloton oil equivalent
Mtoe – Megaton oil equivalent
MS – Member States
NREAPs – National Renewable Energy Action Plans
PR – Renewable Energy Progress Reports
PV – Solar photovoltaic
PJ – Petajoule
RES – Renewable Energy Sources
RES-H/C- Renewable Energy Sources in Heating/Cooling sector
RES-E – Renewable Energy Sources in Electricity sector
RES-T – Renewable Energy Sources in Transport sector
TWh- Terawatt-hour(s)

Units

General conversion factors for energy

1 Mtoe = 41.868 PJ = 11.63 TWh
1 ktoe = 41.868 TJ = 11.63 GWh
1 PJ = 0.278 TWh = 0.024 Mtoe
1 TWh = 3.6 PJ = 0.086 Mtoe
1 TJ = 277.8 MWh

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ANNEX

Table 1. Hydropower installed capacity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	MW	MW	MW	MW	CAGR (%)	MW	CAGR (%)	MW
BE	108	112	117	9	1.13	23	2.3	140
BG	2051	2201	2116	65	0.45	308	1.7	2424
CZ	1020	1061	1065	45	0.62	32	0.4	1097
DK	10	10	9	-1	-1.49	1	1.3	10
DE	4329	4088	4451	122	0.40	-142	-0.4	4309
EE	5	8	8	3	5.78	n.a	-0.3	8
IE	234	234	237	3	0.18	-3	-0.2	234
EL	3107	3433	2537	-570	-2.85	1994	7.5	4531
ES	13084	13408	13293	209	0.23	568	0.5	13861
FR	21046	21835	18669	-2377	-1.70	4827	2.9	23496
IT	15466	16824	14326	-1140	-1.09	3474	2.8	17800
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	1536	1536	1576	40	0.37	-26	-0.2	1550
LT	128	128	116	-12	-1.37	25	2.5	141
LU	34	38	34	n.a	n.a	10	3.3	44
HR	2083	2140	2140	58	0.39	316	1.7	2456
HU	n.a	51	55	55	n.a	12	2.5	67
MT	n.a	0	n.a	n.a	n.a	n.a	n.a	n.a
NL	37	67	37	n.a	n.a	31	7.9	68
AT	7907	8287	7968	61	0.11	1030	1.5	8998
PL	915	972	569	-346	-6.56	583	9.2	1152
PT	4816	5734	5717	901	2.48	3831	6.6	9548
RO	6289	6687	6456	167	0.38	1273	2.3	7729
SI	981	1071	1074	93	1.30	279	2.9	1353
SK	1597	1640	1607	10	0.09	205	1.5	1812
FI	3040	3060	3198	158	0.73	-98	-0.4	3100
SE	16302	16309	16315	13	0.01	2	0.001	16317
UK	4289	4590	1686	-2603	-12.49	3234	14.3	4920
EU-28	110414	115524	105376	-5038	-0.66	21788	2.4	127165

Table 2. Hydropower renewable electricity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	GWh	GWh	GWh	GWh	CAGR (%)	GWh	CAGR (%)	GWh
BE	350.4	372.8	315	-36	-1.52	125	4.3	440
BG	3068	3347	4241	1173	4.73	-529	-1.7	3712
CZ	1618	2215	2129	511	4.0	577	3.0	2706
DK	23	31	23	n.a	n.a	8	3.8	31
DE	19687	18000	21126	1439	1.01	-1126	-0.7	20000
EE	20.1	30	23	3	1.94	7	3.4	30
IE	760	701	759	-1	-0.02	-58	-1.0	701
EL	5017	5360	4126	-891	-2.75	2450	6.0	6576
ES	30350	31033	27594	-2756	-1.35	5220	2.2	32814
FR	70239	69559	59510	-10729	-2.34	12192	2.4	71702
IT	43767	42112	36303	-7464	-2.64	5697	1.8	42000
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	2942	2991	3144	202	0.95	-93	-0.4	3051
LT	451	433	425	-26	-0.84	45	1.3	470
LU	98.1	106	103	5	0.70	21	2.3	124
HR	6546.9	5963	5963	-584	-1.33	716	1.4	6679.1
HU	n.a	193	219	219	n.a	18	1.0	237
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	100	181	100	n.a	n.a	84	7.9	184
AT	37125	38783	35462	-1663	-0.65	6650	2.2	42112
PL	2201	2343	2347	146	0.92	622	3.0	2969
PT	5118	10853	6660	1542	3.83	7413	9.8	14073
RO	16092	17215	12191	-3901	-3.89	7578	6.2	19769
SI	4099	4198	3860	-239	-0.85	1261	3.6	5121
SK	4638	4887	4522	-116	-0.36	878	2.2	5400
FI	13910	14220	13139	-771	-0.81	1281	1.2	14420
SE	68420	68224	78915	10495	2.06	-10915	-1.8	68000
UK	4921	5360	5186	265	0.75	1174	2.6	6360
EU-28	341561.5	348711	328385	-13177	-0.56	41297	1.5	369681.1

Table 3. Geothermal technology absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	2.8	3.5	2.8	n.a	n.a	5.4	14.4	8.2
BG	0.0	2.4	33	33	n.a	-24.0	-15	9.0
CZ	n.a	0.0	n.a	n.a	n.a	16.5	n.a	16.5
DK	n.a	0.0	3.0	3.0	n.a	-3.0	-100	n.a
DE	12.0	122.3	68.2	56	28.1	760.1	36.6	828.2
EE	n.a	0.0	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	0.0	n.a	n.a	n.a	n.a	n.a	n.a
EL	10.0	21.0	13.0	3.0	3.8	101.3	31.2	114.3
ES	3.8	3.8	18.0	14.2	24.9	17.3	8.8	35.3
FR	138.2	213.7	98.4	-39.8	-4.7	442.5	23.7	540.9
IT	671.0	742.6	614.9	-56	-1.2	265.6	4.6	880.5
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LT	1.5	3.0	2.0	0.5	4.2	3.0	12.1	5.0
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	7.4	7.4	7.4	n.a	14.5	14.5	21.9
HU	n.a	120.0	107	107	n.a	285.3	17.6	392.3
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	n.a	75	12.0	12	n.a	247.0	46.8	259
AT	19.2	22.2	22.1	2.9	2.0	18.1	7.8	40.2
PL	11.4	29	15.8	4.4	4.8	162.2	35.4	178
PT	5.7	28	14.2	8.4	13.8	52.8	21.4	67
RO	17.0	35	21.6	4.6	3.5	58.4	17.8	80
SI	16.0	18	31.0	15	9.9	-11.0	-5.3	20
SK	3.0	5.4	6.0	3.0	10.4	86.6	40.8	92.6
FI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
UK	0.8	n.a	0.8	n.a	n.a	-0.8	-100	n.a
EU-28	912.3	1452.4	1091	178.8	2.6	2497.7	16.0	3588.8

Table 4. Geothermal installed capacity progress, absolute and relative deviations in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	MW	MW	MW	MW	CAGR (%)	MW	CAGR (%)	MW
BE	n.a	n.a	n.a	n.a	n.a	3.5	n.a	3.5
BG	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
CZ	n.a	n.a	n.a	n.a	n.a	4.0	n.a	4.0
DK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DE	0.2	27	12	11.8	79.5	286	49.4	298
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EL	n.a	n.a	n.a	n.a	n.a	120	n.a	120
ES	n.a	n.a	n.a	n.a	n.a	50	n.a	50
FR	15	37	16	1.0	0.9	64	22.3	80
IT	711	787	728	17	0.3	192	3.0	920
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	n.a	n.a	n.a	n.a	10.0	n.a	10
HU	n.a	n.a	n.a	n.a	n.a	57.0	n.a	57
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
AT	1.0	1	1.0	n.a	n.a	n.a	n.a	1.0
PL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
PT	14.0	25	25	11.0	8.6	50	14.7	75.0
RO	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SK	n.a	4	n.a	n.a	n.a	4.0	n.a	4.0
FI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
UK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EU-28	741.2	881	782	40.8	0.8	840.5	9.6	1622.5

Table 5. Geothermal renewable electricity progress, absolute and relative deviations in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	GWh	GWh	GWh	GWh	CAGR (%)	GWh	CAGR (%)	GWh
BE	n.a	n.a	n.a	n.a	n.a	29.1	n.a	29.1
BG	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
CZ	n.a	n.a	n.a	n.a	n.a	18	n.a	18
DK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DE	0.2	97	25	24.8	99.3	1629	68.9	1654
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EL	n.a	n.a	n.a	n.a	n.a	736	n.a	736
ES	n.a	n.a	n.a	n.a	n.a	300	n.a	300
FR	95	218	51	-44	-8.5	424	32.2	475
IT	5325	5856	5592	267	0.7	1158	2.4	6750
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	n.a	n.a	n.a	n.a	72	n.a	72
HU	n.a	n.a	n.a	n.a	n.a	410	n.a	410
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
AT	2.0	2	1.0	-1.0	-9.4	1.0	9.1	2.0
PL	n.a	n.a	n.a	n.a	n.a	0.0	n.a	n.a
PT	55	163	146	91	15	342	16.3	488
RO	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SK	n.a	28	n.a	n.a	n.a	30	n.a	30
FI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
UK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EU-28	5477.2	6364	5815	337.8	0.9	5149	8.3	10964

Table 6. Geothermal renewable heat progress, absolute and relative deviations in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	2.8	3.5	2.8	n.a	n.a	3	9.3	5.7
BG	n.a	2	33	33	n.a	-24	-15.0	9
CZ	n.a	n.a	n.a	n.a	n.a	15	n.a	15
DK	n.a	n.a	3	3	n.a	-3	n.a	n.a
DE	12	114	66	54	27.58	620	34.0	686
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EL	10	21	13	3	3.82	38	18.6	51
ES	3.8	3.8	18	14	24.88	-9	-7.7	9.5
FR	130	195	94	-36	-4.53	406	23.2	500
IT	213	239	134	-79	-6.41	166	10.6	300
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LT	1.5	3	2	1	4.20	3	12.1	5
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	7.4	7.4	7	n.a	8	9.9	15.7
HU	n.a	120	107	107	n.a	250	16.3	357
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	n.a	75	12	12	n.a	247	46.8	259
AT	19	22	22	3	2.12	18	7.8	40
PL	11.4	29	15.8	4	4.77	162	35.4	178
PT	1	14	1.6	1	6.94	23	41.0	25
RO	17	35	21.6	5	3.48	58	17.8	80
SI	16	18	31	15	9.91	-11	-5.3	20
SK	3	3	6	3	10.41	84	40.3	90
FI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
UK	0.8	n.a	0.8	0.0	0.00	-1	-100	n.a
EU-28	441.3	905.1	591	150	4.26	2055	20.6	2645.9

Table 7. Marine installed capacity progress, absolute and relative deviations in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	MW	MW	MW	MW	CAGR (%)	MW	CAGR (%)	MW
BE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
BG	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
CZ	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	n.a	n.a	n.a	n.a	75	n.a	75
EL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
ES	n.a	n.a	n.a	n.a	n.a	100	n.a	100
FR	240	256	240	0.0	0.00	140	5.9	380
IT	n.a	n.a	n.a	n.a	n.a	3	n.a	3
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	n.a	n.a	n.a	n.a	n.a	135	n.a	135
AT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
PL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
PT	n.a	5	0.33	n.a	n.a	250	129.0	250
RO	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FI	n.a	n.a	n.a	n.a	n.a	10	n.a	10
SE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
UK	n.a	n.a	7	7	n.a	1293	92.1	1300
EU-28	240	261	247	7	0.43	2006	31.8	2253

Table 8. Marine renewable electricity progress, absolute and relative deviations in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	GWh	GWh	GWh	GWh	CAGR (%)	GWh	CAGR (%)	GWh
BE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
BG	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
CZ	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	n.a	n.a	n.a	n.a	230	n.a	230
EL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
ES	n.a	n.a	n.a	n.a	n.a	220	n.a	220
FR	535	572	458	-77	-2.20	692	12.2	1150
IT	n.a	n.a	n.a	n.a	n.a	5	n.a	5
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	n.a	n.a	n.a	n.a	n.a	514	n.a	514
AT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
PL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
PT	n.a	3	n.a	n.a	n.a	437	342.0	437
RO	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
UK	n.a	n.a	4	4	n.a	3946	136.8	3950
EU-28	535	575	462	-73	-2.07	6044	39.2	6506

Table 9. Solar technology progress, absolute and relative deviations in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	GROWTH 2005-2012		GROWTH 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	3.4	88.1	200.1	197	78.84	97	5.0	296.7
BG	n.a	14.5	85	85	n.a	-27	-4.6	58.4
CZ	2.0	201.4	197.8	196	92.77	41	2.4	238.7
DK	10.2	12.2	38.8	20	16.68	-14	-7.3	16.3
DE	348.3	2056.1	2844.7	2496	34.99	1960	6.8	4804.5
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	7.0	10.2	10	n.a	10	8.7	20
EL	101.1	290	329.7	229	18.40	335	9.2	665
ES	64.5	1262.5	1246.7	1182	52.66	1697	11.3	2943.2
FR	39.9	301.1	515.4	475	44.13	1004	14.5	1519.1
IT	29.7	540.2	1777.1	1747	79.44	785	4.7	2562.1
CY	41.3	66.2	66.3	25	7.01	70	9.4	136.3
LV	n.a	0.1	n.a	n.a	n.a	2	n.a	2.3
LT	n.a	2.3	0.2	n.a	n.a	10	66.8	10.3
LU	1.7	3.6	5.0	3	16.34	10	15.1	15.3
HR	n.a	10.2	10.2	10	175.00	92	33.4	102.4
HU	n.a	14.8	6.7	7	n.a	82	38.2	89.0
MT	n.a	4.1	5.0	5	n.a	1	3.1	6.4
NL	19.4	30.4	47.8	28	13.73	24	5.2	72.0
AT	93.8	154.8	202.0	108	11.58	93	4.9	295.3
PL	0.2	83.2	13.1	13	81.73	493	57.9	506.3
PT	22.3	117	101.2	79	24.15	272	17.7	372.9
RO	n.a	7.3	0.8	1	n.a	97	82.6	97.5
SI	3.0	8.9	23.4	20	34.10	10	4.4	33.0
SK	n.a	14.2	41.5	41	n.a	14	3.8	55.8
FI	n.a	n.a	1.4	1	n.a	-1	-100	n.a
SE	6.0	6.2	12.6	7	11.20	-6	-8.3	6.3
UK	29.7	54.6	255.2	225	35.98	-29	-1.5	226.6
EU-28	816.4	5351	8037.9	7221.5	38.6	7114	8.2	15152

Table 10. Solar installed capacity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	MW	MW	MW	MW	CAGR (%)	MW	CAGR (%)	MW
BE	2	485	2581	2579	177.24	-1241	-7.9	1340
BG	n.a	75	1013	1013	n.a	-710	-14.0	303
CZ	1	1935	2022	2021	196.66	96	0.6	2118
DK	3	3	399	396	101.10	-393	-40.8	6
DE	1980	23783	32643	30663	49.24	19110	5.9	51753
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	n.a	0.7	0.73	n.a	-0.73	-100	n.a
EL	1	531	1536	1535	185.23	914	6.0	2450
ES	60	6697	6603	6543	95.73	5447	7.8	12050
FR	25	1100	4056	4031	106.89	1344	3.6	5400
IT	34	4014	16420	16386	141.78	-7820	-7.8	8600
CY	n.a	12	18	18	95.88	249	40.4	267
LV	n.a	1	n.a	n.a	n.a	2	n.a	2
LT	n.a	3	7	7	n.a	3	4.6	10
LU	24	39	75	51	17.68	38	5.3	113
HR	n.a	6	6	6	n.a	46	29.9	52
HU	n.a	6	12	12	n.a	51	23.0	63
MT	n.a	11	19	19	n.a	9	5.1	28
NL	51	185	365	314	32.47	357	8.9	722
AT	22	120	363	341	49.25	-41	-1.5	322
PL	n.a	2	1	1	n.a	2	14.7	3
PT	3	340	238	235	86.79	1262	25.9	1500
RO	n.a	43	41	41	n.a	219	26.0	260
SI	n.a	22	142	142	n.a	-3	-0.3	139
SK	n.a	130	513	513	n.a	-213	-6.5	300
FI	n.a	n.a	8	8	n.a	2	2.8	10
SE	4	6	24	20	29.17	-16	-12.8	8
UK	11	280	1706	1695	105.83	974	5.8	2680
EU-28	2221	39829	70812	68590	63.98	19688	3.1	90499

Table 11. Solar renewable electricity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	GWh	GWh	GWh	GWh	CAGR (%)	GWh	CAGR (%)	%
BE	1.04	418	2148	2147	197.56	-1009	-7.6	1139
BG	n.a	91	814	814	n.a	-379	-7.5	435
CZ	n.a	2191	2149	2149	n.a	255	1.4	2404
DK	2	2	104	102	75.85	-100	-33.5	4
DE	1282	17397	26380	25098	54.04	15009	5.8	41389
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	n.a	1	1	n.a	-1	-100	n.a
EL	0.9	698	1694	1693	193.64	1911	9.9	3605
ES	41	12378	11938	11897	124.92	14797	10.6	26735
FR	22	1350	4446	4424	113.48	2439	5.6	6885
IT	31	4049	18862	18831	149.89	-7512	-6.2	11350
CY	0.07	19	21	21	126.55	512	49.4	533
LV	n.a	1	n.a	n.a	n.a	4	n.a	4
LT	n.a	3	2	2	n.a	13	28.6	15
LU	17.7	29	38	20	11.53	46	10.4	84
HR	0.1	7	7	7	84.58	53	30.1	59.8
HU	n.a	9	8	8	n.a	73	33.6	81
MT	n.a	16	14	14	n.a	29	15.4	42.66
NL	40	132	254	214	30.22	316	10.6	570
AT	21	114	337	316	48.66	-31	-1.2	306
PL	n.a	2	1	1	n.a	2	13.4	3
PT	3	523	393	390	100.66	2082	25.9	2475
RO	n.a	50	8	8	n.a	312	58.6	320
SI	n.a	22	163	163	n.a	-24	-2.0	139
SK	n.a	130	424	424	n.a	-124	-4.2	300
FI	n.a	n.a	5	5	n.a	-5	n.a	n.a
SE	0.1	2	19	19	111.61	-15	-17.7	4
UK	8	240	1188	1180	104.29	1052	8.3	2240
EU-28	1469.9	39873	71418	69948	74.15	29704	4.4	101122.5

Table 12. Solar renewable heat absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	3.33	52.2	15.3	12	24.3	183	37.8	198.7
BG	n.a	6.7	15	15	n.a	6	4.3	21
CZ	2	13	13	11	30.7	19	11.9	32
DK	10	12	29.9	11	11.2	-5	-3.3	16
DE	238	560	576	338	13.5	669	10.1	1245
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	7	10.2	10	n.a	10	8.8	20
EL	101	230	184	83	8.95	171	8.6	355
ES	61	198	220	159	20.1	424	14.4	644
FR	38	185	133	95	19.6	794	27.5	927
IT	27	192	155	128	28.4	1431	33.7	1586
CY	41.3	64.6	64.47	23	6.6	26	4.3	90.5
LV	n.a	n.a	n.a	n.a	n.a	2	n.a	2
LT	n.a	2	n.a	n.a	n.a	9	n.a	9
LU	0.2	1.1	1.7	2	35.8	6	21.5	8.1
HR	n.a	9.6	9.6	10	n.a	88	33.6	97.3
HU	n.a	14.0	6	6	n.a	76	38.7	82
MT	n.a	2.7	3.88	4	n.a	-1	-4.2	2.8
NL	16	19	26	10	7.2	-3	-1.5	23
AT	92	145	173	81	9.4	96	5.7	269
PL	0.2	83	13	13	81.6	493	58.0	506
PT	22	72	67.4	45	17.34	93	11.4	160
RO	n.a	3	0.1	n.a	n.a	70	126.8	70
SI	3	7	9.4	6	17.7	12	10.6	21
SK	n.a	3	5	5	n.a	25	25.1	30
FI	n.a	n.a	1	1	n.a	-1	n.a	n.a
SE	6	6	11	5	9.1	-5	-7.3	6
UK	29	34	153	124	26.8	-119	-17.1	34
EU-28	690	1922	1896	1206	15.5	4559	16.5	6455.3

Table 13. Wind installed capacity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	MW	MW	MW	MW	CAGR (%)	MW	CAGR (%)	MW
BE	190	1223	1364	1174	32.5	2956	15.5	4320
BG	8	772	677	669	88.5	763	9.9	1440
CZ	22	253	258	236	42.1	315	10.5	573
DK	3129	3841	4163	1034	4.2	-203	-0.6	3960
DE	18415	31358	31304	12889	7.87	14446	4.9	45750
EE	31	311	266	235	35.9	384	11.8	650
IE	494	2370	1763	1269	19.9	2886	12.9	4649
EL	491	2521	1753	1262	19.9	5747	19.9	7500
ES	9918	23555	22775	12857	12.6	12975	5.8	35750
FR	752	8265	7623	6871	39.2	17377	16.0	25000
IT	1639	7040	8102	6463	25.6	4578	5.8	12680
CY	n.a	114	147	147	n.a	153	9.4	300
LV	26	49	59	33	12.4	357	27.7	416
LT	1	250	275	274	123.1	225	7.8	500
LU	35	54	58	23	7.5	73	10.7	131
HR	6	158	158	152	59.6	242	12.3	400
HU	n.a	445	325	325	n.a	425	11.0	750
MT	n.a	n.a	n.a	n.a	n.a	110	n.a	110
NL	1224	2955	2433	1209	10.3	8745	21.0	11178
AT	694	1435	1316	622	9.6	1262	8.8	2578
PL	121	2000	2564	2443	54.7	3536	11.4	6100
PT	1063	5600	4414	3351	22.6	2461	5.7	6875
RO	1	1850	1822	1821	180.9	2178	10.3	4000
SI	n.a	2	n.a	n.a	n.a	106	n.a	106
SK	5	150	3	**-2**	-7.0	347	81.3	350
FI	80	380	257	177	18.1	2243	32.9	2500
SE	536	2408	3606	3070	31.3	941	2.9	4547
UK	1565	8620	8888	7323	28.2	18992	15.4	27880
EU-28	40447	107979	106373	65926	14.8	104620	8.9	210993

Table 14. Wind renewable electricity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	GWh	GWh	GWh	GWh	CAGR (%)	GWh	CAGR (%)	%
BE	319.6	2866	2603	2283	34.93	7871	19.0	10474
BG	5	1390	1039	1034	114.33	1553	12.1	2592
CZ	16	414	416	400	59.27	598	11.8	1014
DK	6614	9694	9332	2718	5.04	2381	2.9	11713
DE	26658	53055	49335	22677	9.19	55100	9.8	104435
EE	54	342	500	446	37.43	1037	15.1	1537
IE	1588	6190	4247	2659	15.09	7723	13.8	11970
EL	1267	5838	3870	2603	17.29	12927	20.1	16797
ES	20729	47585	47560	26831	12.60	24996	5.4	72556
FR	1128	17956	14186	13058	43.57	43714	19.2	57900
IT	2558	10318	12402	9844	25.30	7598	6.2	20000
CY	n.a	189	185	185	n.a	314	13.2	499
LV	47	100	98	51	11.13	812	32.1	910
LT	2	563	562	560	123.78	688	10.5	1250
LU	52.4	98	74	22	5.05	165	15.8	239
HR	9.5	348	348	338	67.24	532	12.3	880
HU	n.a	929	701	701	n.a	844	10.4	1545
MT	n.a	n.a	n.a	n.a	n.a	255	n.a	254.69
NL	2067	6576	4939	2872	13.25	27469	26.5	32408
AT	1343	2844	2412	1069	8.72	2399	9.0	4811
PL	136	4300	4510	4374	64.91	10150	15.9	14660
PT	1773	12600	10260	8487	28.50	4336	4.5	14596
RO	0.227	3316	2645	2645	280.99	5755	15.5	8400
SI	n.a	4	n.a	n.a	n.a	191	n.a	191
SK	7	120	6	-1	-2.18	554	76.3	560
FI	150	820	474	324	17.86	5526	37.3	6000
SE	939	6334	7160	6221	33.67	5340	7.2	12500
UK	2904	23170	18666	15762	30.45	59604	19.6	78270
EU-28	70366.7	217959	198530	128163	15.97	290432	11.9	488962

Table 15. Onshore wind installed capacity progress, absolute and relative deviations in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	MW	MW	MW	MW	CAGR (%)	MW	CAGR (%)	MW
BE	190	720	n.a	-190	-100.0	2320	n.a	2320
BG	8	772	677	669	88.5	763	9.9	1440
CZ	22	253	258	236	42.1	315	10.5	573
DK	2706	2985	3241	535	2.6	-620	-2.6	2621
DE	18415	30566	30869	12454	7.66	4881	1.9	35750
EE	31	311	266	235	35.9	134	5.2	400
IE	469	2334	1738	1269	20.6	2356	11.3	4094
EL	491	2521	1753	1262	19.9	5447	19.3	7200
ES	9918	23555	22775	12857	12.6	12225	5.5	35000
FR	752	7598	7623	6871	39.2	11377	12.1	19000
IT	1639	7040	8102	6463	25.6	3898	5.0	12000
CY	n.a	114	147	147	n.a	153	9.4	300
LV	26	49	59	33	12.4	177	18.9	236
LT	1	250	275	274	123.1	225	n.a	500
LU	35	54	58	23	7.5	73	10.7	131
HR	6	158	158	152	59.6	242	12.3	400
HU	n.a	445	325	325	n.a	425	11.0	750
MT	n.a	n.a	n.a	n.a	n.a	15	n.a	15
NL	1224	2727	2205	981	8.8	3795	13.3	6000
AT	694	1435	1316	622	9.6	1262	8.8	2578
PL	121	2000	2564	2443	54.7	3036	10.3	5600
PT	1063	5600	4412	3349	22.5	2388	5.6	6800
RO	1	1850	1822	1821	180.9	2178	10.3	4000
SI	n.a	2	n.a	n.a	n.a	106	n.a	106
SK	5	150	3	**-2**	-7.0	347	81.3	350
FI	80	n.a	255	175	18.0	1345	25.8	1600
SE	513	2311	3443	2930	31.3	922	3.0	4365
UK	1351	5970	5893	4542	23.4	8997	12.3	14890
EU-28	39762	101770	100237	60475	14.1	68782	6.7	169019

Table 16. Onshore wind renewable electricity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	GWh	GWh	GWh	GWh	CAGR (%)	GWh	CAGR (%)	GWh
BE	319.6	1308.2	n.a	-320	-100	4274	n.a	4274
BG	5	1390	1039	1034	114.3	1553	12.1	2592
CZ	16	414	416	400	59.3	598	11.8	1014
DK	5158	6,400	7270	2112	5.0	-879	-1.6	6391
DE	26658	51152	49335	22677	9.2	23329	5.0	72664
EE	54	342	500	446	37.4	474	8.7	974
IE	n.a	6073	n.a	n.a	n.a	10228	n.a	10228
EL	1267	5838	3870	2603	17.3	12255	19.5	16125
ES	20729	47585	47560	26831	12.6	23174	5.1	70734
FR	1128	15956	14186	13058	43.6	25714	13.8	39900
IT	2558	10318	12402	9844	25.3	5598	4.8	18000
CY	n.a	189	185	185	n.a	314	13.2	499
LV	47	100	98	51	11.1	421	23.1	519
LT	2	563	562	560	123.8	688	10.5	1250
LU	52.4	98	74	22	5.1	165	15.8	239
HR	9.5	348	348	338	67.2	532	12.3	880
HU	n.a	929	701	701	n.a	844	10.4	1545
MT	n.a	n.a	n.a	n.a	n.a	38	n.a	38.32
NL	2067	5773	4156	2089	10.5	9216	15.7	13372
AT	1343	2844	2412	1069	8.7	2399	9.0	4811
PL	136	4300	4510	4374	64.9	8650	14.3	13160
PT	1773	12600	10260	8487	28.5	4156	4.3	14416
RO	0.23	3316	2645	2645	281.0	5755	15.5	8400
SI	n.a	4	n.a	n.a	n.a	191	n.a	191
SK	7	120	6	-1	-2.2	554	76.3	560
FI	150	n.a	n.a	-150	-100	3500	n.a	3500
SE	877	6068	6700	5823	33.7	5300	7.6	12000
UK	2501	14200	11735	9234	24.7	22415	14.3	34150
EU-28	66857.7	198228	180970	114122	15.3	170576	8.7	352426.3

Table 17. Offshore wind installed capacity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	MW	MW	MW	MW	CAGR (%)	MW	CAGR (%)	MW
BE	n.a	503	n.a	n.a	n.a	2000	n.a	2000
BG	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
CZ	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DK	423	856	922	499	11.8	417	4.8	1339
DE	n.a	792	435	435	n.a	9565	48.0	10000
EE	n.a	n.a	n.a	n.a	n.a	250	n.a	250
IE	25	36	25	n.a	0.00	530	47.3	555
EL	n.a	n.a	n.a	n.a	n.a	300	n.a	300
ES	n.a	n.a	n.a	n.a	n.a	750	n.a	750
FR	n.a	667	n.a	n.a	n.a	6000	n.a	6000
IT	n.a	n.a	n.a	n.a	n.a	680	n.a	680
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	n.a	n.a	n.a	n.a	n.a	180	n.a	180
LT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
MT	n.a	n.a	n.a	n.a	n.a	95	n.a	95
NL	n.a	228	228	228	n.a	4950	47.8	5178
AT	n.a	n.a	0	n.a	n.a	n.a	n.a	n.a
PL	n.a	n.a	0	n.a	n.a	500	n.a	500
PT	n.a	n.a	2	2	n.a	73	57.3	75
RO	n.a	n.a	0	n.a	n.a	n.a	n.a	n.a
SI	n.a	n.a	0	n.a	n.a	n.a	n.a	n.a
SK	n.a	n.a	0	n.a	n.a	n.a	n.a	n.a
FI	n.a	n.a	2	2	n.a	898	114.6	900
SE	23	97	163	140	32.28	19	1.4	182
UK	214	2650	2995	2781	45.80	9995	20.1	12990
EU-28	685	5829	4772	4062	31.9	37202	31.2	41974

Table 18. Offshore wind renewable electricity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	GWh	GWh	GWh	GWh	CAGR (%)	GWh	CAGR (%)	GWh
BE	n.a	1558	n.a	n.a	n.a	6200	n.a	6200
BG	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
CZ	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DK	1456	3294	2062	606	5.10	3260	12.6	5322
DE	n.a	1903	n.a	n.a	n.a	31771	n.a	31771
EE	n.a	n.a	n.a	n.a	n.a	563	n.a	563
IE	n.a	117	n.a	n.a	n.a	1742	n.a	1742
EL	n.a	n.a	n.a	n.a	n.a	672	n.a	672
ES	n.a	n.a	n.a	n.a	n.a	1822	n.a	1822
FR	n.a	2000	n.a	n.a	n.a	18000	n.a	18000
IT	n.a	n.a	n.a	n.a	n.a	2000	n.a	2000
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	n.a	n.a	n.a	n.a	n.a	391	n.a	391
LT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
MT	n.a	n.a	n.a	n.a	n.a	216	n.a	216.37
NL	n.a	803	782	782	n.a	18254	49.0	19036
AT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
PL	n.a	n.a	n.a	n.a	n.a	1500	n.a	1500
PT	n.a	n.a	n.a	n.a	n.a	180	206.7	180
RO	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FI	n.a	n.a	n.a	n.a	n.a	2500	n.a	2500
SE	62	266	460	398	33.15	40	1.0	500
UK	403	8970	6931	6528	50.14	37189	26.0	44120
EU-28	1921	18911	10235	8314	27.00	126300	38.2	136535.4

Table 19. Heat pumps progress, absolute and relative deviations in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	7.09	92.8	23	16	18.60	327	40.2	350
BG	n.a	n.a	47	47	n.a	-47	-100	n.a
CZ	12	60	62	50	26.44	95	12.3	157
DK	100	246	117	17	2.2	252	15.5	370
DE	196	599	681	485	19.47	464	6.7	1145
EE	n.a	n.a	n.a	n.a	n.a	0	n.a	n.a
IE	10	31	18	8	8.76	66	21.2	84
EL	4	48	102	98	58.83	177	13.4	279
ES	7.6	22.2	n.a	-8	-100.0	51	n.a	50.8
FR	76	1300	1227	1151	48.79	623	5.3	1850
IT	22	1472	2613	2591	97.87	287	1.3	2900
CY	n.a	0.82	1	1	n.a	2	13.9	2.97
LV	n.a	n.a	n.a	n.a	n.a	4	n.a	4
LT	n.a	4	n.a	n.a	n.a	14	n.a	14
LU	0.2	2.1	1	1	29.17	16	39.2	16.9
HR	n.a	26.4	26	26	n.a	69	17.5	95.6
HU	n.a	8	n.a	n.a	n.a	143	n.a	143
MT	n.a	n.a	2	2	n.a	-2	-100	n.a
NL	54	180	131	77	13.50	246	14.1	377
AT	69	107	145	76	11.19	117	7.7	262
PL	n.a	42	6	6	n.a	142	48.1	148
PT	n.a	n.a	n.a	n.a	n.a	0	n.a	n.a
RO	n.a	1	n.a	n.a	n.a	12	n.a	12
SI	n.a	19	n.a	n.a	n.a	57	n.a	57
SK	n.a	1	n.a	n.a	n.a	10	n.a	10
FI	40	400	315	275	34.29	345	9.7	660
SE	n.a	489	1177	1177	n.a	-132	-1.5	1045
UK	n.a	270	67	67	n.a	2187	55.1	2254
EU-28	597.9	5421.3	6762	6164	41.73	5524	7.5	12287.3

Table 20. Bioenergy absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	631.4	1631.5	1963.9	1333	17.6	1809	8.5	3772.5
BG	724.0	867.3	1010.7	287	4.9	424	4.5	1434.4
CZ	1513.0	2612.3	2399.0	886	6.8	1020	4.5	3418.6
DK	2037.9	2910.1	2611.0	972	3.6	1054.8	2.5	3665.8
DE	10385.2	16106.1	16343.8	5959	6.7	4738	3.2	21081.3
EE	507.8	668.8	741.1	233	5.5	-15	-0.3	726.2
IE	194.3	515.1	326.9	133	7.7	728	15.8	1054.4
EL	960.3	1334	1234.1	274	3.6	714	5.9	1947.8
ES	3833.7	6483	4272.5	439	1.6	4143	8.8	8415.6
FR	9884.4	14000.2	13641.9	3757	4.7	7950	5.9	21591.7
IT	2236.1	4918.7	6911.4	4675	17.5	2904	4.5	9815.1
CY	4.2	42.8	37.3	33	36.6	43	10.1	80.3
LV	1120.5	1186.2	1233.8	113	1.4	341	3.1	1574.4
LT	690.2	837.1	1014.7	325	5.7	280	3.1	1295.2
LU	24.2	75.8	109.3	85	24.1	218	14.7	327.3
HR	352.7	386.1	386.1	33	1.3	214	5.7	599.8
HU	5.0	1190.6	1282.4	1277	120.9	795	6.2	2077.9
MT	n.a	6.2	4.4	4	n.a	25	26.9	29.3
NL	1080.5	2006.9	1711.6	631	6.8	2073	10.4	3785.0
AT	3318.8	4243.5	4908.2	1589	5.7	-275	-0.7	4633.6
PL	267.3	5868.5	6656.1	6303	58.3	1710	2.9	8279.7
PT	2677.9	2892.2	2115.5	-562	-3.3	986	4.9	3101.4
RO	3166.0	3312.4	3862.5	697	2.9	758	2.3	4620.9
SI	453.8	530.6	622.5	169	4.6	153	2.8	775.3
SK	360.8	661.4	687.9	327	9.7	339	5.1	1027.1
FI	6320.8	6560.3	7496.1	1175	2.5	784	1.3	8280.3
SE	7896.0	9690.8	10128.3	2232	3.6	1614	1.9	11741.8
UK	1418.4	3204.4	3189.1	1771	12.3	7180	15.9	10368.8
EU-28	62065	94743.0	96902.3	35150	6.6	42619	5.3	139521.3

Table 21. Biomass absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	631.4	1219.4	1617.9	986.5	14.4	1365.4	7.9	2983.4
BG	724.0	800.3	1010.7	286.7	4.9	136.7	1.6	1147.4
CZ	1510.0	2296.3	2119	609.0	5.0	627.6	3.3	2746.6
DK	2037.9	2665.1	2407.3	369.4	2.4	996.4	4.4	3403.8
DE	8467.2	12767.1	13400.8	4933.6	6.8	2207.5	1.9	15608.3
EE	507.8	654.9	741.1	233.2	5.5	-104.3	-1.9	636.8
IE	193.0	314.2	241.8	48.9	3.3	330.7	11.4	572.5
EL	959.1	1080	1210.1	251.1	3.4	120.1	1.2	1330.3
ES	3696.1	4324	4272.5	576.5	2.1	1429.7	3.7	5702.2
FR	9481.4	11100.2	10799.9	1318.5	1.9	7131.8	6.5	17931.7
IT	2057.1	3596.7	5546.4	3489.4	15.2	1738.7	3.5	7285.1
CY	4.2	24.7	20.3	16.1	25.3	22.1	9.6	42.5
LV	1117.5	1143.2	1212.3	94.8	1.2	285.1	2.7	1497.4
LT	686.6	762.1	953.7	267.1	4.8	174.4	2.1	1128.2
LU	23.2	40.1	62.3	39.2	15.2	49.3	7.6	111.6
HR	352.7	354	354	1.3	0.1	102.7	3.2	456.8
HU	n.a	973.6	1145.4	1145.4	n.a	421.4	4.0	1566.9
MT	n.a	2.4	1.3	1.3	n.a	15.1	37.1	16.5
NL	1080.5	1564.9	1393.6	313.0	3.7	1557.4	9.8	2951.0
AT	3275.8	3837.5	4493.2	1217.4	4.6	-443.6	-1.3	4049.6
PL	213.3	4725.5	5866.6	5653.3	60.6	445.2	0.9	6311.7
PT	2677.9	2609.2	2111.3	-566.7	-3.3	513.1	2.8	2624.4
RO	3166.0	3029.4	3684.2	518.2	2.2	441.2	1.4	4125.4
SI	453.8	482.7	571.5	117.7	3.3	11.6	0.3	583.1
SK	360.8	572.4	601.9	241.2	7.6	235.1	4.2	837.1
FI	6320.8	6260.3	7297.8	977.0	2.1	422.5	0.7	7720.3
SE	7729.0	9223.8	9521.3	1792.2	3.0	1410.5	1.7	10931.8
UK	1343.4	1611.4	2307.1	963.7	8.0	3856.6	13.1	6163.8
EU-28	59070.4	78035.5	84965.5	25895.1	5.3	25500.4	3.3	110465.9

Table 22. Biomass installed capacity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	MW	MW	MW	MW	CAGR (%)	MW	CAGR (%)	MW
BE	340	868	874	534	14.4	1578	13.8	2452
BG	n.a	22	14	14	n.a	144	35.4	158
CZ	36	212	300	264	35.4	64	2.4	364
DK	777	947	1236	459	6.9	1543	10.7	2779
DE	3174	6934	6052	2878	9.7	2773	4.8	8825
EE	n.a	0	67	67	n.a	-67	-100	n.a
IE	20	84	60	40	17.0	93	12.4	153
EL	24	70	45	21	9.4	205	23.9	250
ES	601	984	858	257	5.2	1092	10.8	1950
FR	707	1227	1090	383	6.4	1917	13.5	3007
IT	937	2298	3555	2618	21.0	265	0.9	3820
CY	n.a	6	10	10	n.a	7	6.9	17
LV	10	39	66	56	30.9	134	14.9	200
LT	5	59	53	48	40.1	171	19.7	224
LU	9	20	20	11	12.1	39	14.5	59
HR	2	11	11	9	27.6	114	35.5	125
HU	n.a	381	348	348	n.a	252	7.0	600
MT	n.a	n.a	n.a	n.a	n.a	30	n.a	30
NL	1128	1871	1243	115	1.4	1649	11.1	2892
AT	976	1216	2062	1086	11.3	-781	-5.8	1281
PL	286	720	583	297	10.7	1947	20.1	2530
PT	476	812	606	130	3.5	346	5.8	952
RO	n.a	165	35	35	n.a	565	42.6	600
SI	18	67	59	41	18.5	36	6.1	95
SK	49	165	215	166	23.5	65	3.4	280
FI	2140	2040	1956	-184	-1.3	964	5.1	2920
SE	2568	2730	4055	1487	6.7	-1141	-4.0	2914
UK	1458	2030	3251	1793	12.1	989	3.4	4240
EU-28	15741	25978	28723	12982	9.0	14994	5.4	43717

Table 23. Biomass renewable electricity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	GWh	GWh	GWh	GWh	CAGR (%)	GWh	CAGR (%)	GWh
BE	1791	4103	4348	2557	13.5	6691	12.4	11039
BG	n.a	120	66	66	n.a	799	37.9	865
CZ	721	3166	3372	2651	24.7	1112	3.6	4484
DK	3243	4211	3554	311	1.3	5292	12.1	8846
DE	14025	36710	39579	25554	16.0	9878	2.8	49457
EE	33	336	1001	968	62.8	-655	-12.4	346
IE	116	479	441	325	21.0	565	10.9	1006
EL	94	256	197	103	11.1	1062	26.1	1259
ES	2652	5977	4262	1610	7.0	7938	14.0	12200
FR	3819	6491	5708	1889	5.9	11463	14.8	17171
IT	4675	10671	12342	7667	14.9	6438	5.4	18780
CY	n.a	50	50	50	n.a	93	14.0	143
LV	41	235	289	248	32.2	937	19.8	1226
LT	7	269	218	211	63.4	1005	24.1	1223
LU	46.1	112	91	45	10.2	243	17.6	334
HR	10.9	53	53	42	25.3	645	38.0	697.5
HU	n.a	1995	1656	1656	n.a	1668	9.1	3324
MT	n.a	2	3	3	n.a	168	65.6	171.5
NL	5041	8882	7239	2198	5.3	9400	11.0	16639
AT	2823	4750	4642	1819	7.4	505	1.3	5147
PL	1451	8192	10094	8643	31.9	4124	4.4	14218
PT	1976	2991	3195	1219	7.1	321	1.2	3516
RO	n.a	795	212	212	n.a	2688	38.7	2900
SI	114	415	267	153	12.9	409	12.3	676
SK	32	900	941	909	62.1	769	7.8	1710
FI	9660	9190	10846	1186	1.7	2064	2.2	12910
SE	7570	11856	12189	4619	7.0	4564	4.1	16753
UK	9109	13260	15199	6090	7.6	10961	7.0	26160
EU-28	69050	136467	142054	73004	10.9	91147	6.4	233201

Table 24. Biomass renewable heat absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	477.4	867	1244	767	14.7	790	6.3	2034
BG	724	790	1005	281	4.8	68	0.8	1073
CZ	1448	2024	1829	381	3.4	532	3.2	2361
DK	1759	2303	2102	343	2.6	541	2.9	2643
DE	7261	9610	9997	2736	4.7	1358	1.6	11355
EE	505	626	655	150	3.8	-48	-0.9	607
IE	183	273	204	21	1.6	282	11.5	486
EL	951	1058	1193	242	3.3	29	0.3	1222
ES	3468	3810	3906	438	1.7	747	2.2	4653
FR	9153	10542	10309	1156	1.7	6146	6.0	16455
IT	1655	2679	4485	2830	15.3	1185	3.0	5670
CY	4.2	20	16	12	21.1	14	8.2	30.16
LV	1114	1123	1188	74	0.9	205	2.0	1392
LT	686	739	935	249	4.5	88	1.1	1023
LU	19.2	31	55	35	16.1	28	5.4	82.9
HR	351.8	350	350	-2	-0.1	47	1.6	396.8
HU	n.a	802	1003	1003	n.a	278	3.1	1281
MT	n.a	2	1	1	n.a	1	6.2	1.72
NL	647	801	771	124	2.5	749	8.9	1520
AT	3033	3429	4094	1061	4.4	-487	-1.6	3607
PL	88.5	4021	4999	4910	77.9	91	0.2	5089
PT	2508	2352	1837	-672	-4.4	486	3.0	2322
RO	3166	2961	3666	500	2.1	210	0.7	3876
SI	444	447	549	105	3.1	-24	-0.5	525
SK	358	495	521	163	5.5	169	3.6	690
FI	5490	5470	6365	875	2.1	245	0.5	6610
SE	7078	8204	8473	1395	2.6	1018	1.4	9491
UK	560	471	1000	440	8.6	2914	18.6	3914
EU-28	53132.1	66299	72749	19617	4.6	17662	2.8	90411

Table 25. Solid biomass absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	606.3	1147.4	1497	890.4	13.8	1273.7	8.0	2770.4
BG	724.0	796.6	1011	286.6	4.9	86.6	1.0	1097.2
CZ	1473.2	2057.0	1885	411.6	3.6	432.8	2.6	2317.5
DK	1968.6	2567.6	2303	334.3	2.3	712.9	3.4	3015.7
DE	7657.8	9524.3	9782	2124.0	3.6	1283.1	1.6	11064.9
EE	505.0	626.0	739	233.7	5.6	-131.7	-2.4	607.0
IE	176.7	272.6	216	39.1	2.9	296.3	11.4	512.1
EL	951.0	1064.3	1178	227.0	3.1	75.3	0.8	1253.3
ES	3615.5	4194.9	4143	527.6	2.0	1235.5	3.3	5378.6
FR	9354.3	10912.1	10538	1184.1	1.7	6520.0	6.2	17058.4
IT	1928.0	3087.2	4689	2761.0	13.5	1244.3	3.0	5933.4
CY	4.2	17.4	12	7.5	15.7	12.5	9.5	24.2
LV	1113.4	1107.2	1173	59.5	0.7	225.3	2.2	1398.2
LT	685.3	739.8	946	260.9	4.7	96.5	1.2	1042.7
LU	17.6	27.9	51	33.0	16.3	35.2	6.8	85.8
HR	352.7	348.4	348	-4.3	-0.2	80.0	2.6	428.4
HU	n.a	938.8	1107	1107.2	n.a	349.0	3.5	1456.2
MT	n.a	0.1	1	0.7	n.a	6.7	35.5	7.4
NL	949.2	1241.8	1174	224.6	3.1	506.1	4.6	1679.9
AT	3240.6	3770.3	4392	1151.7	4.4	-411.7	-1.2	3980.6
PL	184.1	4552.2	5733	5548.5	63.4	-219.5	-0.5	5513.2
PT	1865.3	1635.2	2093	228.0	1.7	-483.0	-3.2	1610.2
RO	0.0	3017.2	3674	3674.3	n.a	338.4	1.1	4012.7
SI	408.1	455.4	547	138.6	4.3	-23.0	-0.5	523.6
SK	359.3	531.6	564	204.3	6.6	139.5	2.8	703.1
FI	6279.0	3449.4	7237	957.7	2.0	-2620.8	-5.5	4616.0
SE	7632.9	9132.5	9477	1843.7	3.1	1369.1	1.7	10845.6
UK	866.8	1015.0	1724	857.1	10.3	3658.8	15.3	5382.7
EU-28	52919.0	68230.1	78231	25312.1	5.7	16087.9	2.4	94319.0

Table 26. Solid biomass capacity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	MW	MW	MW	MW	CAGR (%)	MW	CAGR (%)	MW
BE	270	704	678	408	14.1	1329	14.5	2007
BG	n.a	16	14	14	n.a	79	26.7	93
CZ	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DK	740	884	1156	416	6.6	1248	9.6	2404
DE	2427	4017	2034	-393	-2.5	2758	11.3	4792
EE	n.a	n.a	63	63	n.a	-63	-100	n.a
IE	2	22	20	18	38.9	71	20.9	91
EL	n.a	20	n.a	n.a	n.a	40	n.a	40
ES	449	804	640	191	5.2	910	11.7	1550
FR	623	1021	843	220	4.4	1539	13.9	2382
IT	653	1149	1292	639	10.2	348	3.0	1640
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	3	8	23	20	33.8	85	21.3	108
LT	2	40	38	36	52.3	124	19.9	162
LU	4	8	7	3	8.3	23	20.0	30
HR	2	3	3	1	4.4	82	53.9	85
HU	n.a	360	298	298	n.a	202	6.7	500
MT	n.a	n.a	n.a	n.a	n.a	15	n.a	15
NL	966	1597	1007	41	0.6	1246	10.6	2253
AT	892	1103	1672	780	9.4	-508	-4.4	1164
PL	268	600	455	187	7.9	1095	16.6	1550
PT	178	297	555	377	17.6	-188	-5.0	367
RO	n.a	145	30	30	n.a	375	38.4	405
SI	15	23	30	15	10.4	4	1.6	34
SK	47	120	174	127	20.6	-4	-0.3	170
FI	n.a	n.a	1956	1956	n.a	-1956	-100	n.a
SE	2526	2688	3522	996	4.9	-650	-2.5	2872
UK	501	730	2016	1515	22.0	1124	5.7	3140
EU-28	10568	16359	18526	7958	8.3	9328	5.2	27854

Table 27. Solid biomass renewable electricity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	GWh	GWh	GWh	GWh	CAGR (%)	GWh	CAGR (%)	GWh
BE	1521	3534	3685	2164	13.5	5890	12.7	9574.6
BG	n.a	88	65	65	n.a	449	29.5	514
CZ	560	1837	1904	1344	19.1	44	0.3	1948
DK	2960	3926	3176	216	1.0	3169	9.0	6345
DE	10044	19294	12091	2047	2.7	12478	9.3	24569
EE	n.a	n.a	985	985	n.a	-985	-100	n.a
IE	8	158	242	234	62.8	445	13.9	687
EL	n.a	73	n.a	n.a	n.a	364	n.a	364
ES	2029	4999	3396	1367	7.6	6204	13.9	9600
FR	3341	5304	4424	1083	4.1	9046	14.9	13470
IT	3477	5386	4745	1268	4.5	3155	6.6	7900
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	5	49	64	59	44.1	578	33.3	642
LT	3	161	176	173	78.9	634	21.0	810
LU	18.9	45	36	17	9.6	154	23.1	190
HR	10.9	n.a	n.a	-11	-43.5	437	161.5	437.5
HU	n.a	1870	1421	1421	n.a	1267	8.3	2688
MT	n.a	1	n.a	n.a	n.a	86	n.a	86
NL	4758	7637	6195	1437	3.8	5780	8.6	11975
AT	2507	4155	4003	1496	6.9	527	1.6	4530
PL	1340	7700	9529	8189	32.3	671	0.9	10200
PT	934	1188	2986	2052	18.1	-1518	-8.5	1468
RO	n.a	700	192	192		1758	33.6	1950
SI	82	156	114	32	4.8	195	13.2	309
SK	27	600	751	724	60.8	99	1.6	850
FI	9640	4760	10706	1066	1.5	-2846	-3.8	7860
SE	7452	11738	12169	4717	7.3	4466	4.0	16635
UK	4347	6640	9325	4978	11.5	11265	10.4	20590
EU-28	55064.8	92000	92380	37315	7.7	63812	6.8	156192

Table 28. Solid biomass renewable heat absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	475.5	843.4	1180	704	13.9	767	6.5	1947
BG	724	789	1005	281	4.8	48	0.6	1053
CZ	1425	1899	1721	296	2.7	429	2.8	2150
DK	1714	2,230	2030	638	4.6	440	2.5	2470
DE	6794	7865	8742	1948	3.7	210	0.3	8952
EE	505	626	654	149	3.8	-47	-0.9	607
IE	176	259	195	19	1.5	258	11.1	453
EL	951	1058	1178	227	3.1	44	0.5	1222
ES	3441	3765	3851	410	1.6	702	2.1	4553
FR	9067	10456	10158	1091	1.6	5742	5.8	15900
IT	1629	2624	4281	2652	14.8	973	2.6	5254
CY	4.2	17.36	12	7	15.7	12	9.5	24.16
LV	1113	1103	1167	54	0.7	176	1.8	1343
LT	685	726	931	246	4.5	42	0.6	973
LU	16	24	48	32	16.8	22	4.9	69.5
HR	351.8	348.4	348	-3	-0.1	42	1.4	390.8
HU	n.a	778	985	985	n.a	240	2.8	1225
MT	n.a	n.a	1	1	n.a	-1	-100.0	n.a
NL	540	585	641	101	2.5	9	0.2	650
AT	3025	3413	4048	1023	4.3	-457	-1.5	3591
PL	68.9	3890	4913	4844	84	-277	-0.7	4636
PT	1785	1533	1837	52	0.4	-353	-2.6	1484
RO	n.a	2957	3658	3658	n.a	187	0.6	3845
SI	401	442	537	136	4.3	-40	-1.0	497
SK	357	480	499	142	4.9	131	3.0	630
FI	5450	3040	6316	866	2.1	-2376	-5.7	3940
SE	6992	8123	8430	1438	2.7	985	1.4	9415
UK	493	444	922	429	9.4	2690	18.6	3612
EU-28	48183.4	60318.2	70286	22425	5.6	10600	1.8	80886.5

Table 29. Biogas absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	22.1	61.3	121.3	99	27.5	58	5.0	178.8
BG	n.a	3.8	0.1	n.a	n.a	50	121.7	50.2
CZ	36.8	239.3	234.2	197	30.2	195	7.9	429.1
DK	69.3	90.4	82.5	13	2.5	297	21.0	379.4
DE	468.1	2445.1	3427.5	2959	32.9	280	1.0	3707.7
EE	n.a	0.0	2.4	2	n.a	-2	-100	n.a
IE	16.3	41.6	26.0	10	6.9	34	11.1	60.4
EL	8.1	15.7	32.1	24	21.8	45	11.5	77.0
ES	80.6	129.1	129.5	49	7.0	194	12.1	323.6
FR	127.1	188.1	261.4	134	10.9	612	16.3	873.3
IT	129.0	291.0	580.3	451	24	203	3.8	783.7
CY	n.a	7.3	8.6	9	n.a	10	9.9	18.3
LV	4.1	36.0	37.0	33	37	62	13.1	99.2
LT	1.3	22.3	7.6	6	28.1	78	35.3	85.5
LU	5.5	12.3	11.7	6	11.3	14	10.3	25.8
HR	n.a	5.6	5.6	6	n.a	23	22.4	28.4
HU	n.a	34.8	38.2	38	n.a	72	14.2	110.7
MT	n.a	2.3	0.7	1	n.a	8	38.5	9.1
NL	93.3	243.1	218.7	125	12.9	470	15.4	689.1
AT	32.3	64.1	101.0	69	17.7	-35	-5.2	66.0
PL	29.1	173.3	133.9	105	24.3	665	25.0	798.5
PT	12.9	42.1	18.0	5	4.8	64	20.9	82.2
RO	n.a	11.2	9.9	10	n.a	92	33.9	101.7
SI	2.8	22.3	24.9	22	37	7	3.0	31.6
SK	1.4	40.8	38.3	37	60	96	16.9	134.0
FI	41.7	33.4	49.0	7	2.3	34	6.8	83.2
SE	25.6	20.8	44.7	19	8.3	-29	-12.4	15.6
UK	476.5	596.3	583.2	107	2.9	198	3.7	781.0
EU-28	1684.2	4873.2	6228.4	4544	20.5	3794	6.1	10022.9

Table 30. Biogas installed capacity progress, absolute and relative deviations in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	MW	MW	MW	MW	CAGR (%)	MW	CAGR (%)	MW
BE	57	150	141	84	13.8	286	14.9	427
BG	n.a	6	n.a	n.a	n.a	65	n.a	65
CZ	36	212	300	264	35.4	64	2.4	364
DK	37	38	80	43	11.7	269	20.2	349
DE	693	2680	3764	3071	27.4	32	0.1	3796
EE	n.a	0	4	4	n.a	-4	-100	n.a
IE	18	62	40	22	12.1	22	5.6	62
EL	24	50	45	21	9.4	165	21.2	210
ES	152	180	218	66	5.3	182	7.9	400
FR	84	206	247	163	16.7	378	12.3	625
IT	284	602	1274	990	23.9	-74	-0.7	1200
CY	n.a	6	10	10	n.a	8	7.5	17
LV	7	31	43	36	29.6	49	10.0	92
LT	3	19	15	12	25.9	47	19.4	62
LU	5	12	10	5	10.4	19	14.2	29
HR	n.a	8	8	8	n.a	32	22.1	40
HU	n.a	21	50	50	n.a	50	9.1	100
MT	n.a	n.a	n.a	n.a	n.a	15	n.a	15
NL	162	274	219	57	4.4	420	14.3	639
AT	72	98	377	305	26.7	-275	-15.1	102
PL	18	120	128	110	32.3	852	29.0	980
PT	9	80	51	42	28.1	99	14.4	150
RO	n.a	20	5	5	n.a	190	58.1	195
SI	3	44	29	26	38.3	32	9.7	61
SK	2	45	41	39	54	69	13.1	110
FI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SE	42	42	5	-37	-26.2	37	30.5	42
UK	957	1300	1235	278	3.7	-135	-1.4	1100
EU-28	2665	6306	8339	5673	17.7	2894	3.8	11232

Table 31. Biogas renewable electricity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	GWh	GWh	GWh	GWh	CAGR (%)	GWh	CAGR (%)	GWh
BE	235	536	664	429	16	776	10.2	1439.1
BG	n.a	32	1	1	n.a	350	108.0	351
CZ	161	1329	1468	1307	37.1	1068	7.1	2536
DK	283	284	378	95	4.2	2115	26.6	2493
DE	3652	15966	27238	23586	33.3	-3800	-1.9	23438
EE	n.a	0	16	16	n.a	-16	-100.0	n.a
IE	108	321	199	91	9.1	120	6.1	319
EL	94	183	197	103	11.2	698	20.8	895
ES	623	978	866	243	4.8	1734	14.7	2600
FR	478	1187	1284	806	15.2	2417	14.1	3701
IT	1198	2907	4620	3422	21.3	1400	3.4	6020
CY	n.a	50	50	50	n.a	93	14.0	143
LV	36	186	223	187	29.8	361	12.8	584
LT	4	108	42	38	39.9	371	33.1	413
LU	27.2	67	55	28	10.6	89	12.8	144
HR	n.a	53	53	53	n.a	207	22.1	260
HU	n.a	125	235	235	n.a	401	13.3	636
MT	n.a	1	3	3	n.a	82	51.8	85.5
NL	283	1245	1043	760	20.5	3621	20.6	4664
AT	283	559	639	356	12.3	-58	-1.2	581
PL	111	492	565	454	26.2	3453	27.8	4018
PT	34	280	209	175	29.6	316	12.2	525
RO	n.a	95	19	19	n.a	931	62.6	950
SI	32	259	153	121	25.1	214	11.5	367
SK	5	300	190	185	68.1	670	20.8	860
FI	20	40	140	120	32.1	130	8.6	270
SE	53	53	20	-33	-13.0	33	13.0	53
UK	4762	6620	5874	1112	3.0	-304	-0.7	5570
EU-28	12482.2	34256	46445	33962	20.7	17471	4.1	63915.6

Table 32. Biogas renewable heat absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	1.9	15.2	64.2	62	65.4	-9	-1.9	55
BG	n.a	1	n.a	n.a	n.a	20	n.a	20
CZ	23	125	108	85	24.7	103	8.7	211
DK	45	66	50	5	1.5	115	16.1	165
DE	154	1072	1085	931	32.2	607	5.7	1692
EE	n.a	n.a	1	1	n.a	-1	-100	n.a
IE	7	14	8.9	2	3.5	24	17.8	33
EL	n.a	n.a	15.2	15	n.a	-15	-100	n.a
ES	27	45	55	28	10.7	45	7.8	100
FR	86	86	151	65	8.4	404	17.7	555
IT	26	41	183	157	32.2	83	4.8	266
CY	n.a	3	4.32	4	n.a	2	4.2	6
LV	1	20	17.8	17	50.9	31	13.5	49
LT	1	13	4	3	21.9	46	37.1	50
LU	3.2	6.5	7	4	11.8	6	8.5	13.4
HR	n.a	1.1	1.1	1	n.a	5	23.6	6
HU	n.a	24	18	18	n.a	38	15.2	56
MT	n.a	2.21	0.41	n.a	n.a	1	19.6	1.72
NL	69	136	129	60	9.4	159	10.6	288
AT	8	16	46	38	28.4	-30	-12.4	16
PL	19.6	131	85.3	66	23.4	368	23.2	453
PT	10	18	0	-10	-100	37	n.a	37
RO	n.a	3	8.2	8	n.a	12	11.8	20
SI	n.a	n.a	11.7	12	n.a	-12	-100	n.a
SK	1	15	22	21	55.5	38	13.4	60
FI	40	30	37	-3	-1.1	23	6.2	60
SE	21	16.2	43	22	10.8	-32	-15.7	11
UK	67	27	78	11	2.2	224	18.4	302
EU-28	610.7	1927.2	2234.1	1623	20.4	2292	9.2	4526.1

Table 33. Bioliquids absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	3.0	10.8	n.a	-3	-100	34	n.a	34.1
BG	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
CZ	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DK	n.a	8.1	22	22	n.a	-13	-11	8.7
DE	341.3	797.7	191.5	-150	-7.92	644	20.2	835.7
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
ES	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IT	n.a	218.5	277	277	n.a	291	9.4	568
CY	n.a	n.a	n.a	n.a	n.a	n.a	-100	n.a
LV	n.a	n.a	2.4	2	n.a	-2	-100	n.a
LT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	38	80.0	n.a	-38	-100	582	n.a	582
AT	2.8	3.1	n.a	-3	-100	3	n.a	3.1
PL	0.0	n.a	n.a	n.a	n.a	0	n.a	n.a
PT	799.7	932.0	n.a	-800	-100	932	n.a	932
RO	n.a	1.0	n.a	n.a	n.a	11	n.a	11
SI	43	5.0	n.a	-43	-100	28	n.a	28
SK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FI	n.a	2777.5	12	12	n.a	3009	99.6	3021.1
SE	70.6	70.6	n.a	-71	-100	71	n.a	70.6
UK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EU-28	1298.4	4904.3	504.9	-793.5	-12.6	5589.3	36.5	6094.2

Table 34. Bioliquids installed capacity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	MW	MW	MW	MW	CAGR (%)	MW	CAGR (%)	MW
BE	13	14	55	42	23	-38	-13	18
BG	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
CZ	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DK	n.a	26	n.a	n.a	n.a	26	n.a	26
DE	54	237	254	200	25	-17	-1	237
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
ES	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IT	n.a	547	989	989	n.a	-9	n.a	980
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	n.a	n.a	17	17	n.a	-17	-100	n.a
AT	12	15	13	1	1	2	2	15
PL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
PT	289	435	n.a	-289	-100	435	n.a	435
RO	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SE	n.a	n.a	528	528	n.a	-528	-100	n.a
UK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EU-28	368	1274	1856	1488	26	-146	-1	1711

Table 35. Bioliquids renewable electricity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	GWh	GWh	GWh	GWh	CAGR (%)	GWh	CAGR (%)	GWh
BE	35	32.5	n.a	-35	-100	25	n.a	24.8
BG	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
CZ	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DK	n.a	1.0	n.a	n.a	n.a	8	n.a	8
DE	329	1450	250	-79	-3.85	1200	24.6	1450
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
ES	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IT	n.a	2378	2977	2977	n.a	1883	6.3	4860
CY	n.a	n.a	0.20	0.20	n.a	-0.2	-100	n.a
LV	n.a	n.a	1	1	n.a	-1	-100	n.a
LT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
AT	33	36	n.a	-33	-100	36	n.a	36
PL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
PT	1008	1523	n.a	-1008	-100	1523	n.a	1523
RO	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FI	n.a	4390	n.a	n.a	n.a	4780	n.a	4780
SE	65	65	n.a	-65	-100	65	n.a	65
UK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EU-28	1470	9875.5	3228	1758	11.89	9519	18.7	12746.8

Table 36. Bioliquids renewable heat absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	n.a	8	n.a	n.a	n.a	32	n.a	32
BG	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
CZ	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
DK	n.a	8	22	22	n.a	-14	-11.9	8
DE	313	673	170	-143	-8.4	541	19.6	711
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
ES	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IT	n.a	14	21	21	n.a	129	27.9	150
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	n.a	n.a	2	2	n.a	-2	-100	n.a
LT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	38	80	n.a	-38	-100	582	n.a	582
AT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
PL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
PT	713	801	n.a	-713	-100	801	n.a	801
RO	n.a	1	n.a	0	n.a	11	n.a	11
SI	43	5	n.a	-43	-100	28	n.a	28
SK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FI	n.a	2400	12	12	n.a	2598	96	2610
SE	65	65	n.a	-65	-100	65	n.a	65
UK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
EU-28	1172	4055	227	-945	-20.9	4771	47.2	4998

Table 37. Biomass in households' absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	GROWTH 2005-2012		GROWTH 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	191.3	263.8	789	597.8	22.4	-435.3	-9.5	353.8
BG	724	785	759	35	0.7	253.0	3.7	1012
CZ	1039	1212	1140	101	1.3	243.0	2.4	1383
DK	700	978	848	148.4	2.8	99.6	1.4	948
DE	4407	5648	6397	1990	5.5	-422	-0.8	5975
EE	292.9	369.34	387	94.1	4.1	-53.2	-1.8	333.85
IE	16	23	27	11	7.8	-3.0	-1.5	24
EL	585	609	954	369	7.2	-359	-5.7	595
ES	2029	2067	2485	456	2.9	-368	-2.0	2117
FR	6549	6945	7155	606	1.3	245	0.4	7400
IT	1145	1762	3619	2474	17.9	1.0	0.0	3620
CY	1.77	7.82	6	4.0	18.3	6.1	9.5	11.87
LV	770	737	665	-105.4	-2.1	129.4	2.2	794
LT	58	54	562	504.2	38.3	-523.2	-28.4	39
LU	16	20.5	18	1.6	1.4	17.6	9.1	35.2
HR	298.7	313.8	314	15.1	0.7	-6.8	-0.3	307
HU	n.a	606	724	724	n.a	194	3.0	918
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	159	159	302	143	9.6	-143	-7.7	159
AT	2690	2778	1686	-1004	-6.5	1219	7.0	2905
PL	n.a	0	2791	2790.9	n.a	-2790.9	-100	n.a
PT	1164	652	767	-397	-5.8	-163	-2.9	604
RO	3166	2811	3284	117.7	0.5	-607.7	-2.5	2676
SI	329	354	471	142.3	5.3	-77.3	-2.2	394
SK	33	37	37	4.0	1.6	18	5.1	55
FI	1110	1050	1330	220	2.6	-230	-2.3	1100
SE	1043	1107	1189	146	1.9	-9.0	-0.1	1180
UK	n.a	48	383	383	n.a	326	8.0	709
EU-28	28516.7	31397.3	39088	10571.7	4.6	-3439.6	-1.1	35648.72

Table 38. Biofuels in transport absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	n.a	412	346	346	n.a	443	10.9	789.
BG	n.a	67	n.a	n.a	n.a	287	n.a	287
CZ	3	316	280	277	91.2	392	11.6	672
DK	n.a	245	204	204	n.a	58	3.2	262
DE	1918	3339	2943	1025	6.3	2530	8.1	5473
EE	n.a	14	n.a	n.a	n.a	89	n.a	89.4
IE	1.28	201	85	84	82.1	397	24.2	481.9
EL	1.2	254	24	23	53.4	594	50.1	617.5
ES	137.6	2159	n.a	-138	-100	2713	n.a	2713.4
FR	403	2900	2842	2439	32.2	818	3.2	3660
IT	179	1322	1365	1186	33.7	1165	8.0	2530
CY	n.a	18	17	17	n.a	21	10.5	37.84
LV	3	43	22	19	32.5	56	17.3	77
LT	3.6	75	61	57	49.8	106	13.4	167
LU	1	36	47	46	73.3	169	21.0	215.7
HR	n.a	32	32	32	n.a	111	20.5	143
HU	5	217	137	132	60.5	374	17.9	511
MT	n.a	4	3	3	n.a	10	19.8	12.82
NL	n.a	442	318	318	n.a	516	12.8	834
AT	43	406	415	372	38.3	169	4.4	584
PL	54	1143	790	736	46.7	1178	12.1	1968
PT	n.a	283	4	4	n.a	473	80.7	477
RO	n.a	283	178	178	n.a	317	13.6	495.5
SI	n.a	48	51	51	n.a	141	18.0	192.2
SK	n.a	89	86	86	n.a	104	10.4	190
FI	n.a	300	198	198	n.a	362	13.9	560
SE	167	467	607	440	20.3	203	3.7	810
UK	75	1593	882	807	42.2	3323	21.6	4205
EU-28	2994.7	16707	11937	8942	21.8	17119	11.8	29055.4

Table 39. Bioethanol/bio-ETBE absolute and relative progress in EU MS, 2005-202

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	n.a	43.5	48	48	n.a	43.2	8.4	91.2
BG	n.a	3.0	n.a	n.a	n.a	60	n.a	60
CZ	n.a	65	59	59	n.a	69	10.2	128
DK	n.a	98	n.a	n.a	n.a	94	n.a	94
DE	144	1145	792	648	27.6	65	1.0	857
EE	n.a	5.6	n.a	n.a	n.a	38	n.a	38
IE	n.a	60	29	29	212.3	110	21.6	139
EL	n.a	171	n.a	n.a	n.a	414	n.a	414
ES	113	281	n.a	-113	-100	400	n.a	400
FR	75.0	550	418	343	27.8	232	5.7	650.
IT	n.a	238	103	103	n.a	497	24.6	600
CY	n.a	n.a	n.a	n.a	n.a	14.7	n.a	14.7
LV	n.a	17	6.4	6.4	n.a	11.6	13.8	18.0
LT	0.8	22	9.0	8.2	41.3	27.0	18.9	36.0
LU	n.a	4.0	1.0	1.0	n.a	22.1	48.1	23.1
HR	n.a	n.a	n.a	n.a	n.a	16.3	n.a	16.3
HU	5.0	82	34	29	31.5	270	31.5	304
MT	n.a	2.5	n.a	n.a	n.a	5.8	n.a	5.8
NL	n.a	202	124	124	n.a	158	10.8	282
AT	n.a	56	67	67	n.a	13	2.2	80
PL	38.0	308	153.9	116	22.1	297.1	14.4	451
PT	n.a	n.a	n.a	n.a	n.a	27.0	n.a	27
RO	n.a	94	37	37	n.a	126	20.4	163
SI	n.a	4.6	5.3	5.3	n.a	13.2	16.9	18.5
SK	n.a	17	14.5	14.5	n.a	60.5	22.8	75
FI	n.a	90	90	90	n.a	40	4.7	130
SE	144	294	197	53	4.6	268	11.3	465
UK	18.0	217	387	369	55	1356	20.7	1743.0
EU-28	537.8	4070.2	2575.1	2037.3	25.1	4748.5	14.0	7323.6

Table 40. Biodiesel absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	n.a	368.6	298.0	298	n.a	399.9	11.2	697.9
BG	n.a	64	n.a	n.a	n.a	220	n.a	220
CZ	3.0	251	221	218	84.8	274	10.6	495
DK	n.a	147	n.a	n.a	n.a	167	n.a	167
DE	1598	2086	2034	436	3.5	2409	10.3	4443
EE	n.a	8.2	n.a	n.a	n.a	51.1	n.a	51.1
IE	0.8	140	56	55.2	84.5	286	25.4	342
EL	1.2	83	24	22.8	53.4	179	30.6	203
ES	24.0	1878	n.a	-24	-100	2313	n.a	2313
FR	328	2350	2424	2096	33.1	426	2.0	2850
IT	179	1070	1262	1083	32.2	618	5.1	1880
CY	n.a	18.1	17.0	17	n.a	6.2	4.0	23.2
LV	3.0	25.0	15.1	12.1	26	12.9	8.0	28
LT	2.8	53.0	52.0	49.2	51.8	79.0	12.2	131
LU	1.0	31.7	46.0	45	72.8	146.7	19.6	192.7
HR	n.a	32.1	32.1	32.1	n.a	89.5	18.1	121.6
HU	n.a	135	103.0	103	n.a	99	8.8	202
MT	n.a	1.3	3.0	3.0	n.a	4.0	11.1	7.0
NL	n.a	240	194	194	n.a	358	14	552
AT	35	285	348	313	38.8	62	2.1	410
PL	16	835	635.6	619.6	69.2	815.4	10.9	1451
PT	n.a	283	4.2	4.2	n.a	445.8	79.4	450
RO	n.a	189	141.3	141.3	n.a	184.7	11	326
SI	n.a	43.3	45.7	45.7	n.a	128	18.2	173.7
SK	n.a	72	71.5	71.5	n.a	38.5	5.5	110
FI	n.a	210	108	108	n.a	322	18.9	430
SE	9.0	122	331	322	67.4	-80	-3.4	251
UK	57	1376	471	414	35.2	1991	23	2462
EU-28	2257.8	12397.3	8937.5	6679.8	21.7	12045.7	11.3	20983

Table 41. Other biofuels absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
BG	n.a	n.a	n.a	n.a	n.a	7.0	n.a	7.0
CZ	n.a	n.a	n.a	n.a	n.a	49.0	n.a	49
DK	n.a	n.a	n.a	n.a	n.a	0.0	n.a	n.a
DE	177	108	117	-60	-5.7	56.0	5.0	173
EE	n.a	0.1	n.a	n.a	n.a	0.3	n.a	0.3
IE	0.5	0.9	0.1	-0.4	-23	0.8	35.3	0.9
EL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
ES	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FR	n.a	n.a	n.a	n.a	n.a	160	n.a	160
IT	n.a	14	n.a	n.a	n.a	50	n.a	50
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	n.a	1	n.a	n.a	n.a	31	n.a	31
LT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	n.a	n.a	n.a	n.a	5.1	n.a	5.1
HU	n.a	n.a	n.a	n.a	n.a	5.0	n.a	5.0
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
AT	8.0	65	n.a	-8.0	-100	94	n.a	94
PL	n.a	n.a	n.a	n.a	n.a	66	n.a	66
PT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
RO	n.a	n.a	n.a	n.a	n.a	6.5	106.1	6.5
SI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SK	n.a	n.a	n.a	n.a	n.a	5.0	n.a	5.0
FI	n.a	n.a	n.a	n.a	n.a	-0.3	-100	n.a
SE	13	51	79	66	29.4	15	2.2	94
UK	n.a	n.a	24	24	n.a	-24	-100	n.a
EU-28	198.5	240	220.4	21.9	1.5	526.4	16.5	746.8

Table 42. Biofuels Art.21.2 absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	n.a	n.a	n.a	n.a	n.a	63	n.a	63
BG	n.a	n.a	n.a	n.a	n.a	4	n.a	4.0
CZ	n.a	n.a	n.a	n.a	n.a	292	n.a	292
DK	n.a	n.a	n.a	n.a	n.a	131	n.a	131
DE	n.a	115	392	392	n.a	13.5	0.4	405.5
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	0.9	85.1	84.6	108.3	-84.2	-43.4	0.9
EL	n.a	n.a	24	24	n.a	-24	-100	n.a
ES	n.a	45	n.a	n.a	n.a	252	n.a	252
FR	n.a	n.a	125	125	n.a	-75	-10.8	50
IT	21	157	341	320	48.9	59	2.0	400
CY	n.a	0.4	0.1	0.1	n.a	37.7	110	37.8
LV	n.a	n.a	n.a	n.a	n.a	44	n.a	44
LT	n.a	n.a	61	61	n.a	-61	-100	n.a
LU	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HR	n.a	n.a	n.a	n.a	n.a	50.3	n.a	50.3
HU	n.a	18	17	17	n.a	10.0	6.0	27
MT	n.a	1.27	3	3	n.a	0.1	0.5	3.2
NL	n.a	68	194	194	n.a	-39.0	-2.8	155
AT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
PL	n.a	88	128.6	128.6	n.a	113.4	8.2	242
PT	n.a	5	4.2	4.2	n.a	3.8	8.4	8.0
RO	n.a	n.a	n.a	n.a	n.a	110.5	n.a	110.5
SI	n.a	n.a	51	51	n.a	-51	-100	n.a
SK	n.a	n.a	n.a	n.a	n.a	60	n.a	60
FI	n.a	20	105	105	n.a	75	7.0	180
SE	13	51	183	170	45.9	-89	-8.0	94
UK	n.a	n.a	472	472	n.a	-472	-100	n.a
EU-28	34.5	569.6	2186	2151.5	80.9	424.2	2.2	2610.2

Table 43. Imported biofuels absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	n.a	n.a	52.7	53	n.a	-53	-100	n.a
BG	n.a	n.a	n.a	n.a	n.a	10	n.a	10
CZ	6	94	n.a	-6	-100	172	n.a	172
DK	n.a	245	n.a	n.a	n.a	261	n.a	261
DE	n.a	1611	n.a	n.a	n.a	3124	n.a	3124
EE	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
IE	n.a	70	62	62	n.a	277	23.7	339
EL	n.a	171	n.a	n.a	n.a	414	n.a	414
ES	n.a	475	n.a	n.a	n.a	231	n.a	231
FR	13	450	436	424	66.10	14	0.4	450
IT	n.a	273	1054	1054	n.a	-54	-0.7	1000
CY	n.a	10.2	10.63	11	n.a	27	17.0	37
LV	n.a	n.a	15.8	16	n.a	1	0.9	17
LT	n.a	n.a	40	40	n.a	-40	-100	n.a
LU	1	35.7	47	46	73.33	169	21.0	216
HR	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
HU	n.a	n.a	52	52	n.a	-52	-100	n.a
MT	n.a	2.5	n.a	n.a	n.a	10	n.a	10
NL	n.a	350	n.a	n.a	n.a	516	n.a	516
AT	34	164	288	254	35.69	-102	-5.3	186
PL	n.a	n.a	31.09	31	n.a	-31	-100	n.a
PT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
RO	n.a	n.a	110.2	110	n.a	-110	-100	n.a
SI	n.a	n.a	50.1	50	n.a	-50	-100	n.a
SK	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
FI	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
SE	117	121	n.a	-117	-100	292	n.a	292
UK	n.a	1432.3	651	651	n.a	3036	24.2	3687
EU-28	171	5504.7	2900.5	2730	49.91	8061	18.1	10962

Table 44. Renewable electricity absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	Growth 2005-2012		Growth 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	16.4	29.9	26.8	10.4	7.3	70.4	17.5	97.2
BG	3.0	4	6.1	3.1	10.7	8.9	11.9	15
CZ	6.0	11	9.0	3.0	6.0	13.0	11.8	22
DK	9.0	13	18.1	9.1	10.5	10.9	6.1	29
DE	169	272	188.0	19	1.5	479.0	17.2	667
EE	n.a	0.1	0.9	0.9	n.a	-0.3	-4.9	0.6
IE	1.0	1.0	0.6	-0.4	-7.5	36.4	68.1	37
EL	n.a	4.0	3.2	3.2	n.a	13.3	22.8	16.5
ES	107.4	172.1	114	6.6	0.9	388.6	20.4	502.6
FR	141	212.0	209	68	5.8	193	8.5	402
IT	139	209.0	186	47	4.2	183	8.9	369
CY	n.a	0.1	n.a	n.a	n.a	0.6	n.a	0.6
LV	4.0	3.0	4.7	0.7	2.3	1.3	3.1	6.0
LT	n.a	0.8	n.a	n.a	n.a	2.5	n.a	2.5
LU	1.1	2.5	2.0	0.9	8.9	8.4	22.9	10.4
HR	8.4	10.0	10	1.6	2.5	8.6	8.1	18.6
HU	n.a	9.0	17	17	n.a	7.0	4.4	24
MT	n.a	n.a	n.a	n.a	n.a	0.7	n.a	0.7
NL	8.0	16	30.0	22	20.8	41	11.4	71
AT	162	176	173	11	0.9	99	5.8	272
PL	n.a	19	54.2	54.2	n.a	-16.2	-4.3	38
PT	12	26	14.6	2.6	2.8	43.4	18.8	58
RO	40.9	35.6	34.5	-6.4	-2.4	18.2	5.4	52.7
SI	3.9	6.2	4.4	0.5	1.7	6.1	11.5	10.5
SK	8.0	9.0	9.9	1.9	3.1	7.1	7.0	17
FI	20	20	18	-2	-1.5	22	10.5	40
SE	121	157	129	8	0.9	69	5.5	198
UK	113	156	69	-44	-6.8	198	18.4	267
EU-28	1094.1	1574.3	1332	237.9	2.9	1912.8	11.8	3245

Table 45. Renewable electricity from CHP absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	GROWTH 2005-2012		GROWTH 2012-2020		2020 NREAPS
	GWh	GWh	GWh	GWh	CAGR (%)	GWh	CAGR (%)	GWh
BE	75.6	984.7	1791	1715.4	57.2	1189.4	6.6	2980.4
BG	n.a	120	66	66	n.a	799	37.9	865
CZ	475	3346	2848	2373	29.2	1654	5.9	4502
DK	3243	4210	3552	308.5	1.3	5286.5	12.1	8838
DE	n.a	7681	19073	19073	n.a	1718	1.1	20791
EE	33	336	597	564	51.2	-251	-6.6	346
IE	13	47	40	27	17.4	521	39.1	561
EL	n.a	73	n.a	n.a	n.a	147	n.a	147
ES	747	1532	n.a	-747	-100	2551	n.a	2551
FR	3372	6491	3248	-124	-0.5	13923	23.1	17171
IT	2388	3327	5193	2805	11.7	662	1.5	5855
CY	n.a	n.a	50	50.0	n.a	-50	-100	n.a
LV	40	220	283	242.9	32.2	647	16.0	930
LT	7	268	n.a	-7.0	-100	1223	n.a	1223
LU	27.2	103	56	28.8	10.9	262	24.2	318
HR	n.a	0.1	n.a	n.a	n.a	437.5	n.a	437.5
HU	n.a	142	268	268	n.a	2722	35.2	2990
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	1583	3700	4752	3169	17.0	3537	7.2	8289
AT	1718	3255	2533	815	5.7	1077	4.5	3610
PL	1451	2556	10094	8643.3	31.9	-5025	-8.3	5069
PT	1304	1967	1721	417	4.0	246	1.7	1967
RO	n.a	795	159	158.6	n.a	2741.4	43.8	2900
SI	114	415	262	148.4	12.6	413.6	12.6	676
SK	32	900	941	909.0	62.1	769	7.8	1710
FI	8480	8750	9568	1088.0	1.7	2772	3.2	12340
SE	7571	11856	12194	4623.0	7.0	4560	4.1	16754
UK	n.a	210.2	1176	1176.0	n.a	714	6.1	1890
EU-28	32673.8	63285.	80465	47790.9	13.7	45246	5.7	125711

Table 46. Renewable heat in district heating absolute and relative progress in EU MS, 2005-2020

	2005 NREAPs	2012 NREAPs	2012 PR	GROWTH 2005-2012		GROWTH 2012-2020		2020 NREAPS
	ktoe	ktoe	ktoe	ktoe	CAGR (%)	ktoe	CAGR (%)	ktoe
BE	3.8	22.9	n.a	-3.8	-100	33.9	n.a	33.9
BG	n.a	14	n.a	n.a	n.a	91	n.a	91
CZ	54	120	79	25	5.6	112	11.7	191
DK	854	1105	1301	447	6.2	185	1.7	1486
DE	n.a	1576	641	641	n.a	1919	18.9	2560
EE	195	235	268	73	4.6	-20	-1.0	248
IE	n.a	29	n.a	n.a	n.a	131	n.a	131
EL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
ES	1.4	5.8	n.a	-1.4	-100	38.6	n.a	38.6
FR	368	775	n.a	-368	-100	3200	n.a	3200
IT	80	208	171	91	11.5	729	23.1	900
CY	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
LV	103	124	121	17.5	2.3	136.5	9.9	257
LT	17	33	244	226.6	46.3	-192.6	-17.8	51
LU	3	10	3	0.1	0.5	44.6	40.7	47.7
HR	n.a	31.7	32	31.7	n.a	38.6	10.5	70.3
HU	n.a	18	85	85.	n.a	528	28.0	613
MT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
NL	415	528	230	-185.0	-8.1	515	15.8	745
AT	343	650	890	547.0	14.6	-188	-2.9	702
PL	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
PT	n.a	n.a	n.a	n.a	n.a	n.a	n.a	n.a
RO	17	188	16	-1.0	-0.9	1284	73.3	1300
SI	8	24	n.a	-8.0	-100	48	n.a	48
SK	52	74	176	124.0	19.0	184	9.4	360
FI	830	660	759	-71.0	-1.3	501	6.5	1260
SE	2505	2802	3050	545.0	2.9	91	0.4	3141
UK	n.a	62	n.a	n.a	n.a	230	n.a	230
EU-28	5849.2	9295.4	8065	2215.7	4.7	9639.6	10.3	17704.5

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